IMPACT OF STRATEGIC DEFENSE INITIATIVE [SDI] ON THE U.S. INDUSTRIAL BASE

HEARING

BEFORE THE

SUBCOMMITTEE ON ECONOMIC STABILIZATION

OF THE

COMMITTEE ON
BANKING, FINANCE AND URBAN AFFAIRS
HOUSE OF REPRESENTATIVES

NINETY-NINTH CONGRESS

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IMPACT OF STRATEGIC DEFENSE INITIATIVE [SDI] ON THE U.S. INDUSTRIAL BASE

TUESDAY, DECEMBER 10, 1985

House of Representatives,
Subcommittee on Economic Stabilization,
Committee on Banking, Finance and Urban Affairs,
Washington, DC.

The subcommittee met, pursuant to call, at 2:15 p.m., in room 2128, Rayburn House Office Building, Hon. John J. LaFalce (chairman of the subcommittee) presiding.

Present: Chairman LaFalce; Representatives Vento, Torres, and McCandless.

Chairman **LaFalce**. The Subcommittee on Economic Stabilization will come to order.

In a historic break from offense-oriented deterrence strategy, President Reagan has committed his administration to a strategic defense program, known as the strategic defense initiative [SDI]. At this point, the SDI is essentially a research effort, an attempt to discover whether further research and eventual implementation of space defense would be useful and feasible. Nevertheless, substantial sums are already being committed to the program—almost $3 billion in fiscal year 1986—and since the President's announcement of this initiative over 2 years ago, an entire industry has grown up around the project.

The SDI presents extremely complex strategic issues. But controversy has not been confined to the program's arguable strategic benefits. Substantial controversy has focused on its impact on the United States and foreign economies. Over the past several months, Defense Secretary Weinberger and Lt. Gen. James Abrahamson have been conducting talks with our allies in an attempt to negotiate their participation in SDI research, either on a U.S. Government-to-foreign firm basis or preferably, but less typically, a government-to-government basis. While many foreign governments remain reluctant to participate officially for political reasons, these governments are nonetheless working hard to facilitate the participation of their private firms.

Today's hearing will focus on the impact of administration policy regarding SDI research on our industrial base. Serious concern has been expressed about the offsetting benefits that may be provided to foreign governments and corporations in what some perceive as an attempt to win political support for SDI. It appears that the administration is willing to pay other governments and foreign corporations to conduct research for SDI and allow other countries and foreign corporations the right to control and market commercial products which are based on the technology developed by this U.S.-financed research. The impact of such policies on our high-tech research capability, the competitive position of U.S. high technology industries, and U.S. employment and production could be substantial and warrants careful examination.

We are pleased to have with us today Dr. Gerold Yonas, Chief Scientist and Acting Deputy Director of the Strategic Defense Initiative Organization; John Pike, Associate Director for Space Policy at the Federation of American Scientists; and Alice Tepper Marlin, Executive Director of the Council on Economic Priorities.

Before we proceed, and the three witnesses can all come to the table at the same time, if they would, I would ask other members of the subcommittee if they have opening statements. I feel confident Mr. Vento does, because it was Mr. Vento who has been most interested on this subcommittee in this issue, who talked with me about the need for hearings on it, and who is probably most knowledgeable about it. Mr. Vento.

Mr. VENTO. Thank you, Mr. Chairman and members.

I want to hear from our witnesses, but clearly I want to acknowledge and express my thanks to you for the hearing and to the witnesses for their cooperation. I regret that General Abrahamson is unable to be with us, but I hope we will have him here at a later date to discuss the issue.

I have expressed concerns about this issue because of the magnitude and percentage of total U.S. dollars being put into R&D with regard to this initiative and the impact on our ability to be competitive in the future if indeed significant portions of this R&D, as apparently is the intent, are to be shared with our allies.

So I hope that we can get some answers today, Mr. Chairman.

I know that we would all like to read what was in the first memorandum of understanding that was executed last Friday, and any other memoranda of agreement that might be executed in the near future with the United Kingdom or our other allies concerning these matters. This would answer many of the questions which we will be raising today. I think that the policy, upon which the Department is embarking, will have a tremendous impact.

In the past, Mr. Chairman, we have talked about offsets in terms of coproduction agreements and so forth, but I think that the difference in this is that this reaches down to the very bowels of our ability as a technological society to compete in the future. It is quite a difference in magnitude and in character than past coproduction agreements we have had.

I think we on the subcommittee are trying to understand better this type of joint venture and the impact on our industrial base. This issue certainly has the potential, I think, to have a tremendous impact on our economy in the future.

So I am most anxious to understand the designs and the agreements and covenants that the administration is pursuing and what their evaluation is of the impact of these actions and policy. So, with that sort of an elaborate comment, I will yield and look forward to our witnesses responding to us.

Chairman LAFALCE. Thank you very much. Any other comments on the part of the subcommittee?

Although when I asked for all the witnesses to testify to come to the table, we will first hear from Dr. Yonas, and we will question him, and then we will go on to the other panelists. Dr. Yonas, please proceed. However, I would advise you we will incorporate the entire text of your remarks in the record. We would ask that you summarize your remarks.

Also I would ask you to exclude from your summary a strategic justification of the strategic defense initiative [SDI], and confine your summary to the questions that we posed in inviting you to testify.

STATEMENT OF GEROLD YONAS, CHIEF SCIENTIST AND ACTING DEPUTY DIRECTOR, STRATEGIC DEFENSE INITIATIVE ORGANIZATION

Mr. **YONAS**. Thank you, Mr. Chairman. With your pleasure, I would like to introduce into the record the remarks prepared by General Abrahamson. I am sorry he couldn't be here today.

[At this point the prepared statements of Lt. Gen. James A. Abrahamson and Lt. Gen. William E. Odom were inserted in the record:]

STATEMENT ON

THE STRATEGIC DEFENSE INITIATIVE

BY

LIEUTENANT GENERAL JAMES A. ABRAHAMSON
DIRECTOR, STRATEGIC DEFENSE INITIATIVE ORGANIZATION

BEFORE THE

SUBCOMMITTEE ON ECONOMIC STABILIZATION
COMMITTEE ON BANKING, FINANCE, AND URBAN AFFAIRS
HOUSE OF REPRESENTATIVES

99th CONGRESS, FIRST SESSION

DECEMBER 10, 1985

THANK YOU MR. CHAIRMAN FOR THE OPPORTUNITY TO APPEAR BEFORE YOUR COMMITTEE AND DISCUSS THE ISSUES SURROUNDING THE VERY IMPORTANT SUBJECT OF ALLIED PARTICIPATION IN THE STRATEGIC DEFENSE INITIATIVE. I APPRECIATE YOUR INTEREST IN THIS MATTER AND LOOK FORWARD TO ADDRESSING YOUR QUESTIONS.

I WOULD LIKE TO BRIEFLY HIGHLIGHT SOME SALIENT POINTS WITH RESPECT TO THE SDI. AN APPRECIATION OF THE UNDERLYING TENETS OF THE PROGRAM IS, WE FEEL, ESSENTIAL TO ANY FUNDAMENTAL DISCUSSIONS ON MATERIAL ISSUES SUCH AS ALLIED PARTICIPATION. I WILL KEY ON DETERRENCE AND THE PART SDI COULD BE EXPECTED TO PLAY AND RELATE THIS PERSPECTIVE TO THE ALLIES AND THEIR ROLE. REASONS FOR THEIR INVOLVEMENT IN OUR EFFORTS WILL BE FOLLOWED BY A SHORT SUMMATION OF POSSIBLE MECHANISMS FOR WORKING WITH INTERESTED COUNTRIES.

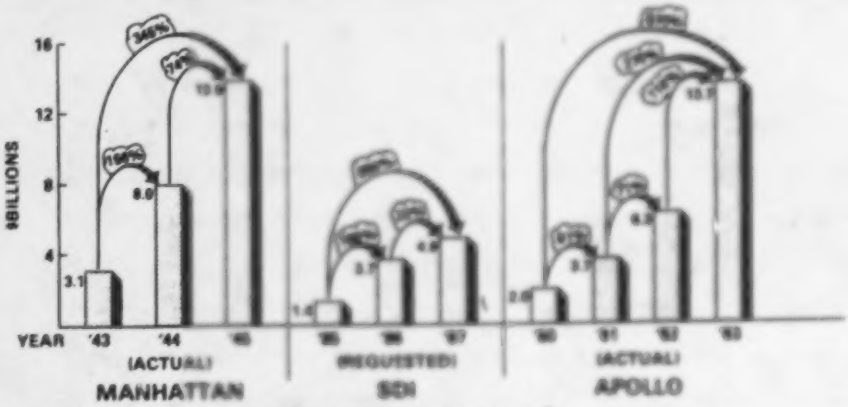
SINCE THE PRESIDENT'S SPEECH IN 1983, WE HAVE SEEN MANY INTERPRETATIONS OF WHAT HIS VISION ENTAILED AND WHAT THE SDI WAS EXPECTED TO ACCOMPLISH. IN SPITE OF WHAT WOULD APPEAR TO BE MANY CONFLICTING REPORTS FROM VARIOUS QUARTERS, I WOULD LIKE TO EMPHASIZE THAT OUR GOAL HAS NOT CHANGED, AND HAS IN FACT, REMAINED CONSISTENT WITH THE DIRECTION OUTLINED BY THE PRESIDENT. THE DRIVING FORCE BEHIND HIS CONCEPT IS TO RENDER NUCLEAR BALLISTIC MISSILES IMPOTENT AND OBSOLETE, A VITAL STEP TOWARD

FREEING THE WORLD FROM THE FEAR OF NUCLEAR CONFLICT. TO MOVE TOWARD THIS OBJECTIVE THE SDI HAS BEEN STRUCTURED AS A PROGRAM OF VIGOROUS RESEARCH FOCUSED ON ADVANCED DEFENSIVE TECHNOLOGIES WITH THE AIM OF FINDING WAYS TO PROVIDE A BETTER BASIS FOR DETERRING AGGRESSION, STRENGTHENING STABILITY, AND INCREASING THE SECURITY OF THE UNITED STATES AND OUR ALLIES. AS I HAVE REPEATEDLY DONE, I WOULD STRESS THAT THE SDI IS A RESEARCH PROGRAM GEARED TO PROVIDE A FUTURE PRESIDENT AND CONGRESS THE TECHNICAL KNOWLEDGE REQUIRED TO SUPPORT A DECISION ON WHETHER TO DEVELOP AND LATER DEPLOY ADVANCED STRATEGIC DEFENSIVE SYSTEMS. SUCH DEPLOYMENT WOULD ENHANCE DETERRENCE WHILE PROVIDING CRITICAL LEVERAGE FOR PROGRESSIVELY DEEPER NEGOTIATED REDUCTIONS IN NUCLEAR WEAPONS.

AT THE SAME TIME, THERE ARE THOSE WHO PERSIST IN RAISING OBJECTIONS TO THE SDI THAT ARE SIMPLY NOT BASED ON FACT. OVER THE PAST YEAR, WE HAVE SEEN A PROGRAM INITIATED WITH THE NORMAL PROBLEMS ASSOCIATED WITH STARTUP, COMBINED WITH THE TRIBULATIONS ATTENDANT TO A PROGRAM OF GREAT MAGNITUDE AND RAPID GROWTH. SOME FELT THAT IT WOULD NOT BE POSSIBLE TO EXECUTE SUCH A PROGRAM, THAT THE FUNDING RAMPS WERE TOO GREAT, THAT IT WAS NOT FEASIBLE TO ABSORB INCREASES AS BUDGETED. COMPARISONS WITH OTHER SIMILAR PROGRAMS OF NATIONAL PRIORITY, SUCH AS APOLLO, BELIE THESE ASSERTIONS. GROWTH IN THE SDI, EVEN AT REQUESTED LEVELS, LET ALONE CURRENTLY AUTHORIZED LEVELS, IS CERTAINLY NO GREATER THAN, AND AT MOST POINTS, LESS THAN, GROWTH IN THESE LIKE PROGRAMS.

COMPARATIVE FUNDING

('85 DOLLARS)
SDI GROWTH LESS THAN
COMPARABLE NATIONAL PRIORITY PROGRAMS



[@ $2.75B AUTHORIZATION LEVEL,
'85 TO '86 RAMP = 99%;
'87 WILL NECESSARILY BE LESS]

FURTHERMORE, WE MAINTAINED AN OBLIGATION RATE FOR THE SDI THAT EXCEEDED OTHER DEFENSE AGENCIES THROUGHOUT THE YEAR. 94 PERCENT OF OUR PROGRAM WAS OBLIGATED BY THE END OF THE FISCAL YEAR. THIS IS A PARTICULARLY NOTEWORTHY ACCOMPLISHMENT THAT WAS UNDERSCORED BY THE GENERAL ACCOUNTING OFFICE'S COMPLIMENTARY REVIEW AND FINDINGS FOR CONGRESS THAT VALIDATED THIS PERFORMANCE EARLIER THIS YEAR.

OBLIGATIONS ARE NOT THE WHOLE STORY, HOWEVER. EXPENDITURE RATES COMPARED FAVORABLY WITH OTHER RESEARCH AGENCIES AND ACTIVITIES WITHIN THE DEPARTMENT OF DEFENSE. FOR FISCAL YEAR 1985, EXPENDITURES FOR THE SDI WERE 40 PERCENT. THIS IS NOT A LOW

FIGURE. RATES FOR ACTIVITIES SIMILARLY ORIENTED TOWARD RESEARCH, SUCH AS THE DEFENSE ADVANCED RESEARCH PROJECTS AGENCY AND THE AIR FORCE STRATEGIC R&D ACCOUNT, WERE COMPARABLE OR LESS THAN THAT OF THE SDIO.

BUT EVEN AT THAT, WE FEEL THAT OUR PERFORMANCE BY THIS MEASURE IS BETTER THAN THE FIGURES WOULD INDICATE. WHEREAS OBLIGATIONS OCCUR WHEN CONTRACTS ARE EXECUTED OR PROJECTS ACCEPTED, EXPENDITURES BASICALLY OCCUR AFTER CONSUMPTION, SOMETIMES YEARS LATER. THIS IS DUE TO DELAYS IN THE BILLING, EITHER BY SUBCONTRACTORS TO PRIMES, OR TO THE GOVERNMENT DIRECTLY, DELAYS IN THE ACCOUNTING SYSTEMS, DELAYS IN THE PAYMENTS PROCESS, AND/OR DELAYS IN THE FINAL DATA SUMMARIES. BECAUSE OF THIS, WE FEEL THE TRADITIONAL MEASURES, ALTHOUGH IMPORTANT, ARE INADEQUATE TO REFLECT THE EFFECTIVE USE OF RESOURCES.

CONSEQUENTLY, WE ARE LOOKING TOWARD THE USE OF A FINANCIAL PARAMETER THAT IS MORE CLOSELY RELATED TO PERFORMANCE. WE TERM THIS MEASURE "NONCANCELABLE COMMITMENTS," WHICH ARE DEFINED AS COSTS INCURRED DURING A GIVEN PERIOD REPRESENTING LIABILITIES FOR GOODS AND SERVICES RECEIVED, OTHER ASSETS ACQUIRED, AND PERFORMANCE ACCEPTED, WHETHER OR NOT PAYMENT HAS BEEN MADE. IF WE APPLY THIS STANDARD OVER THE PAST FISCAL YEAR, A MUCH MORE DYNAMIC PICTURE EMERGES. OUR OCTOBER ESTIMATE WAS THAT NEARLY 90 PERCENT OF OUR FUNDING HAS BEEN DEDICATED TO NONCANCELABLE COMMITMENTS. WE ARE STILL CAREFULLY PURSUING THE COMMITMENT

ISSUE, WHICH IS ESPECIALLY PERTINENT TO THIS PROGRAM. ALL IN ALL, WE FEEL THAT THIS IS A TRULY EXCEPTIONAL ACCOMPLISHMENT BY DEDICATED, PROFESSIONAL, AND PRUDENT MANAGEMENT TEAMS FOR A PROGRAM OF THIS SCALE IN ITS FIRST YEAR. CREDIT RESTS NOT ONLY WITH THE PROGRAM OFFICE, BUT MORE IMPORTANTLY WITH THE HUNDREDS OF AGENCIES, FIRMS, AND INSTITUTIONS ALONG WITH THE THOUSANDS OF INDIVIDUALS ACROSS AMERICA THAT ARE DEDICATED TO THE SUCCESS OF THE PRESIDENT'S INITIATIVE. .

I WOULD AGAIN REITERATE THAT THE STRATEGIC DEFENSE INITIATIVE HAS BEEN STRUCTURED FROM THE OUTSET AS BEING FULLY COMPLIANT WITH ALL TREATY OBLIGATIONS, INCLUDING THE 1972 ABM TREATY. IF AND WHEN OUR RESEARCH CRITERIA ARE MET, AND FOLLOWING CLOSE CONSULTATIONS WITH OUR ALLIES, WE INTEND TO CONSULT AND NEGOTIATE, AS APPROPRIATE, WITH THE SOVIETS PURSUANT TO THE TERMS OF THE ABM TREATY, WHICH PROVIDE FOR SUCH CONSULTATIONS, ON HOW DETERRENCE COULD BE ENHANCED THROUGH GREATER RELIANCE BY BOTH SIDES ON NEW DEFENSIVE SYSTEMS. THIS COMMITMENT SHOULD IN NO WAY BE INTERPRETED AS ACCORDING THE SOVIETS A VETO OVER POSSIBLE FUTURE DEFENSIVE DEPLOYMENTS. AND, IN FACT, WE HAVE ALREADY BEEN TRYING TO INITIATE A DISCUSSION OF THE OFFENSE-DEFENSE RELATIONSHIP AND STABILITY IN THE DEFENSE AND SPACE TALKS UNDER WAY IN GENEVA TO LAY THE FOUNDATION TO SUPPORT SUCH FUTURE POSSIBLE CONSULTATIONS;

THE WHITE HOUSE HAS SET FORTH SEVERAL COGENT THEMES THAT CAPTURE THE ESSENCE OF THE PROGRAM AND BEAR REPEATING:

- THE AIM OF THE SDI IS NOT TO SEEK SUPERIORITY, BUT TO MAINTAIN THE STRATEGIC BALANCE AND THEREBY ASSURE STABLE DETERRENCE;

- RESEARCH WILL LAST FOR SOME YEARS. WE INTEND TO ADHERE STRICTLY TO ABM TREATY LIMITATIONS AND WILL INSIST THAT THE SOVIETS DO SO AS WELL;

- WE DO NOT HAVE ANY PRECONCEIVED NOTIONS ABOUT THE DEFENSIVE OPTIONS THE RESEARCH MAY GENERATE. WE WILL NOT PROCEED TO DEVELOPMENT AND DEPLOYMENT UNLESS THE RESEARCH INDICATES THAT DEFENSES MEET STRICT CRITERIA;

- WITHIN THE SDI RESEARCH PROGRAM, WE WILL JUDGE DEFENSES TO BE DESIRABLE ONLY IF THEY ARE SURVIVABLE AND COST-EFFECTIVE AT THE MARGIN;

- IT IS TOO EARLY IN OUR RESEARCH PROGRAM TO SPECULATE ON THE KINDS OF DEFENSIVE SYSTEMS - WHETHER GROUND-BASED OR SPACE-BASED AND WITH WHAT CAPABILITIES - THAT MIGHT PROVE FEASIBLE AND DESIRABLE TO DEVELOP AND DEPLOY;

- THE PURPOSE OF THE DEFENSIVE OPTIONS WE SEEK IS CLEAR - TO FIND A MEANS TO DESTROY ATTACKING BALLISTIC MISSILES BEFORE THEY CAN REACH ANY OF THEIR POTENTIAL TARGETS;

- U.S. AND ALLIED SECURITY REMAINS INDIVISIBLE. THE SDI

PROGRAM IS DESIGNED TO ENHANCE ALLIED SECURITY AS WELL AS U.S. SECURITY. WE WILL CONTINUE TO WORK CLOSELY WITH OUR ALLIES TO ENSURE THAT, AS OUR RESEARCH PROGRESSES, ALLIED VIEWS ARE CAREFULLY CONSIDERED;

- IT IS OUR INTENTION AND OUR HOPE THAT, IF NEW DEFENSIVE TECHNOLOGIES PROVE FEASIBLE, WE (IN CLOSE AND CONTINUING CONSULTATION WITH OUR ALLIES) AND THE SOVIETS WILL JOINTLY MANAGE A TRANSITION TO A MORE DEFENSE-RELIANT BALANCE;

- SDI REPRESENTS NO CHANGE IN OUR COMMITMENT TO DETERRING WAR AND ENHANCING STABILITY. WE WOULD DETER A POTENTIAL AGGRESSOR BY MAKING IT CLEAR THAT WE COULD DENY HIM THE GAINS HE MIGHT OTHERWISE HOPE TO ACHIEVE RATHER THAN MERELY THREATENING HIM WITH COSTS LARGE ENOUGH TO OUTWEIGH THOSE GAINS;

- FOR THE FORESEEABLE FUTURE, OFFENSIVE NUCLEAR FORCES AND THE PROSPECT OF NUCLEAR RETALIATION WILL REMAIN THE KEY ELEMENT OF DETERRENCE. THEREFORE, WE MUST MAINTAIN MODERN, FLEXIBLE, AND CREDIBLE STRATEGIC NUCLEAR FORCES;

- THE ULTIMATE GOAL IS TO ELIMINATE NUCLEAR WEAPONS ENTIRELY. BY NECESSITY, THIS IS A VERY LONG-TERM GOAL, WHICH REQUIRES, AS WE PURSUE OUR SDI RESEARCH, EQUALLY ENERGETIC EFFORTS TO DIMINISH THE THREAT POSED BY CONVENTIONAL ARMS

IMBALANCES, BOTH THROUGH CONVENTIONAL FORCE IMPROVEMENTS, AND THE NEGOTIATION OF ARMS REDUCTIONS AND CONFIDENCE BUILDING MEASURES.

EVEN THOUGH THE POINT HAS BEEN MADE ABOVE, I WOULD EMPHASIZE AGAIN THAT THE POTENTIAL OFFERED BY THE STRATEGIC DEFENSE INITIATIVE TO TRULY ENHANCE DETERRENCE IS A FUNDAMENTAL ELEMENT AMONG THE COMPELLING REASONS FOR THE PROGRAM. A GOVERNMENT'S PRIME RESPONSIBILITY IS TO PROVIDE FOR THE SECURITY OF ITS PEOPLE. WE, ALONG WITH OUR ALLIES, HAVE OPTED FOR DETERRENCE OF AGGRESSION AS BEING THE MOST CERTAIN COURSE TO ASSURE THIS SECURITY AND OUR SURVIVAL AS FREE AND INDEPENDENT NATIONS. THE STRATEGIC DEFENSE INITIATIVE HAS SIGNIFICANT POTENTIAL TO LEND MEANINGFUL SUPPORT TO THIS COURSE.

THERE ARE OTHER SIGNIFICANT WAYS IN WHICH A DEFENSE AGAINST BALLISTIC MISSILES WILL HELP TO ENSURE AGAINST NUCLEAR CONFLICT. IN THE ARMS CONTROL ARENA, THE SDI COMPLEMENTS AND SUPPORTS U.S. EFFORTS TO SEEK EQUITABLE, VERIFIABLE REDUCTIONS IN OFFENSIVE NUCLEAR FORCES. DEFENSES COULD ALSO PROVIDE PROTECTION AGAINST ACCIDENTAL MISSILE LAUNCHES OR LAUNCHES BY SOME FUTURE IRRATIONAL LEADER IN POSSESSION OF A NUCLEAR ARMED MISSILE. ADDITIONALLY, THE SDI PROGRAM IS A PRUDENT HEDGE IN THE FACE OF VERY AGGRESSIVE SOVIET RESEARCH AND DEVELOPMENT ACTIVITIES IN STRATEGIC DEFENSE.

THE PRESIDENT HAS SAID REPEATEDLY THAT THE SDI IS INTENDED TO EXAMINE THE POTENTIAL FOR BALLISTIC MISSILE DEFENSE FOR THE UNITED STATES AND FOR OUR ALLIES. TODAY I WOULD LIKE TO FOCUS ON THE ASPECT OF DETERRENCE AS IT RELATES TO OUR ALLIES.

DETERRENCE REQUIRES THAT NO DOUBT BE LEFT IN THE MIND OF A POTENTIAL AGGRESSOR THAT THE RISKS AND COSTS OF AGGRESSION FAR OUTWEIGH ANY GAINS THAT MIGHT BE SOUGHT. IN THE WORDS OF PRIME MINISTER MARGARET THATCHER IN HER ADDRESS TO THE CONGRESS LAST FEBRUARY, "OUR TASK IS TO SEE THAT POTENTIAL AGGRESSORS FROM WHATEVER QUARTER UNDERSTAND PLAINLY THAT THE CAPACITY AND RESOLVE OF THE WEST WOULD DENY THEM VICTORY IN WAR; AND THAT THE PRICE THEY WOULD PAY WOULD BE INTOLERABLE." WE, TOGETHER WITH OUR ALLIES, HAVE CONSISTENTLY PURSUED THIS COURSE. IN RECENT YEARS, HOWEVER, THE CONCEPT OF DETERRENCE AT THE STRATEGIC LEVEL HAS FOCUSED ALMOST COMPLETELY ON ONE APPROACH, THAT IS, POSING TO AN AGGRESSOR UNACCEPTABLE COSTS THROUGH THE ULTIMATE THREAT OF NUCLEAR RETALIATION. THIS ALMOST EXCLUSIVE RELIANCE ON THE THREAT OF RETALIATION WITH OFFENSIVE FORCES - WITHOUT THE ABILITY TO DENY AN AGGRESSOR HIS OBJECTIVES THROUGH DEFENSIVE FORCES - HAS NOT ALWAYS BEEN THE CASE.

DEFENSIVE SYSTEMS ARE CONSISTENT WITH A POLICY OF DETERRENCE BOTH HISTORICALLY AND THEORETICALLY. IN THE 1950's AND 1960's, ENORMOUS EFFORT WAS DEVOTED TO STRATEGIC DEFENSE OF NORTH AMERICA. EVERY MAJOR CITY WAS RINGED WITH NIKE-AJAX AND NIKE-HERCULES GROUND-TO-AIR MISSILES AND MORE THAN 2,500 AIRCRAFT

WERE DEDICATED TO AIR DEFENSE. THIS COMBINED WITH ALLIED AND AMERICAN RETALIATORY FORCES TO PROVIDE A POTENT DETERRENT CAPABILITY. WHEN THE SOVIET EMPHASIS SHIFTED FROM BOMBERS TO THE INTERCONTINENTAL BALLISTIC MISSILE, THIS DEFENSIVE CAPABILITY WAS ALLOWED TO DECLINE SINCE THERE WERE AT THAT TIME, NO EFFECTIVE MEASURES TO DEFEND AGAINST SUCH MISSILES.

AS WE MOVED TOWARD MORE DEPENDENCE ON OFFENSIVE DETERRENCE, WE DID SO IN FULL CONSULTATION WITH OUR ALLIES, TAKING INTO ACCOUNT THE OTHER CONTRIBUTORS OR REQUIREMENTS FOR DETERRENCE i.e. CONVENTIONAL FORCES AND THEATER NUCLEAR FORCES. THE ULTIMATE DETERRENT REMAINS U.S. STRATEGIC OFFENSIVE FORCES. WE AND OUR ALLIES DEVELOPED THE STRATEGY OF FLEXIBLE RESPONSE - THE CORNERSTONE OF U.S. AND ALLIED SECURITY FOR ALMOST 20 YEARS. WE IN NO WAY SEEK TO DISCARD THIS STRATEGY, BUT RATHER LOOK TOWARD STRENGTHENING ITS VERY FLEXIBILITY. AS WE LOOK TOWARD THE FUTURE, THE CONTINUING GROWTH AND SOPHISTICATION OF SOVIET OFFENSIVE FORCES, AS WELL AS THEIR DEFENSIVE CAPABILITIES, WOULD, IF LEFT UNCHECKED AND UNANSWERED, RAPIDLY PLACE OUR DETERRENT CAPACITY - AS REPRESENTED BY U.S. AND ALLIED FORCES - IN QUESTION, REDUCING OR LIMITING THE OPTIONS SO IMPORTANT TO OUR FLEXIBLE RESPONSE STRATEGY. THE SDI OFFERS THE OPPORTUNITY TO SHIFT THE DETERRENT STANCE FROM THIS INCREASINGLY QUESTIONABLE FOUNDATION BASED PRIMARILY ON THE ULTIMATE THREAT OF DEVASTATING NUCLEAR RETALIATION TO ONE IN WHICH NON-NUCLEAR DEFENSES PLAY A GREATER AND GREATER ROLE.

AS SECRETARY WEINBERGER HAS POINTED OUT, "ULTIMATELY, WE ALL MUST REALIZE THAT IN A NUCLEAR WORLD WE SHARE A COMMON DESTINY AND ARE UNITED IN OUR VULNERABILITY TO NUCLEAR ATTACK. THAT IS WHY WE MUST WORK TOGETHER TO BRING OUR BEST MINDS TO THE FORMIDABLE TASK OF UNLOCKING SCIENTIFIC KNOWLEDGE THAT CAN UNITE US ALL IN A WORLD WHERE NO NATION NEED FEAR THE SUDDEN ADVENT OF NUCLEAR WAR..." THIS OPPORTUNITY IS MANIFESTED IN A NUMBER OF WAYS FOR BOTH OURSELVES AND OUR ALLIES.

SUCH AN APPROACH WOULD PROVIDE A FAR SOUNDER BASIS FOR A STABLE AND RELIABLE STRATEGIC RELATIONSHIP. AN AGGRESSOR'S UNCERTAINTIES REGARDING HIS OFFENSIVE WEAPONS' EFFECTIVENESS WOULD BE MARKEDLY INCREASED. THIS REDUCED CONFIDENCE - BECAUSE THE U.S. AND ITS ALLIES WOULD BE MORE CAPABLE OF DENYING AN AGGRESSOR'S MILITARY OBJECTIVES - WOULD MAKE THE AGGRESSOR MUCH LESS LIKELY TO CONTEMPLATE INITIATING A NUCLEAR CONFLICT, EVEN IN CRISIS SITUATIONS. AT THE SAME TIME, THIS WOULD MEAN A REDUCTION IN THE UTILITY, OR PERCEIVED VALUE, OF BALLISTIC MISSILES, WHICH IS A GIANT STEP TOWARD RENDERING THEM IMPOTENT AND OBSOLETE. ON BALANCE, THE LIKELIHOOD OF NUCLEAR CONFLICT WOULD BE VASTLY REDUCED, AND THAT IS THE ESSENCE OF EFFECTIVE STRATEGIC DETERRENCE.

THE FOREGOING, AS WELL AS MOST CURRENT DISCOURSE, DOES CENTER ON NUCLEAR DETERRENCE. WHILE OUR ALLIES HAVE JOINED US IN THIS PRESENT POSTURE, THERE IS, HOWEVER, ANOTHER FACET OF DETERRENCE THAT MAY HOLD FOR THEM EQUAL OR EVEN GREATER RELEVANCE. TOO

OFTEN, IN THE DEBATE SURROUNDING THE SDI, THE QUESTION OF CONVENTIONAL DETERRENCE IS NOT IN THE FOREFRONT.

OF ALLIED FORCES IN EUROPE, FOR EXAMPLE, 95 PERCENT OF THE DIVISIONS, 85 PERCENT OF THE TANKS, AND 80 PERCENT OF THE COMBAT AIRCRAFT ARE PROVIDED, MANNED, AND PAID FOR BY THE EUROPEAN ALLIES. SOVIET DOCTRINE SEEMS TO BE EVOLVING ALONG LINES THAT PLACE EVER GREATER VALUE ON TACTICAL BALLISTIC MISSILES AND THE HAVOC THEY COULD WREAK ON NATO FORCES. SOVIET SS-20s AND OTHER SHORTER-RANGE MISSILES PRESENTLY PROVIDE OVERLAPPING CAPABILITIES TO STRIKE ALL NATO EUROPE, AS WELL AS OUR ASIAN ALLIES. THEIR DOCTRINE STRESSES THE USE OF CONVENTIONALLY-ARMED (AND POSSIBLY CHEMICALLY-ARMED) BALLISTIC MISSILES TO INITIATE RAPID AND WIDE-RANGING ATTACKS ON CRUCIAL MILITARY TARGETS IN ORDER TO CRIPPLE THE ABILITY TO COUNTER THE INITIAL THRUST OF A SOVIET ATTACK WITHIN, AND TO INHIBIT RESUPPLY AND REINFORCEMENT FROM WITHOUT.

SO FAR, SOVIET MILITARY PLANNERS HAVE HAD A FREE RIDE ON THE USE OF BALLISTIC MISSILES IN ANY DESIGNS FOR AGGRESSION IN A TACTICAL APPLICATION (JUST AS THEY HAVE IN THE STRATEGIC REALM). EVEN A MODEST DEFENSE AGAINST TACTICAL BALLISTIC MISSILES WOULD HAVE A MAJOR EFFECT ON THE SITUATION. NOT ONLY WOULD THERE BE SIGNIFICANTLY INCREASED COSTS FOR OFFENSIVE FORCES TO MAINTAIN THE SAME LEVEL OF ADVANTAGE ENJOYED TODAY, BUT OTHER TECHNOLOGIES AND THE CHANGING NATURE OF OPERATIONS AND TACTICS WOULD INTERACT

WITH DEFENSES TO CREATE ALTOGETHER MORE COMPLEX PROBLEMS FOR THE PLANNER ENTERTAINING ANY THOUGHTS OF AGGRESSION.

BY REDUCING OR ELIMINATING THE MILITARY EFFECTIVENESS OF BALLISTIC MISSILES, BOTH TACTICAL AND STRATEGIC, DEFENSIVE SYSTEMS THUS HAVE THE VERY REAL POTENTIAL FOR ENHANCING DETERRENCE AGAINST NOT ONLY STRATEGIC NUCLEAR CONFLICT, BUT ALSO AGAINST NUCLEAR, CHEMICAL, AND CONVENTIONAL ATTACKS ON OUR ALLIES AS WELL. LIEUTENANT GENERAL WILLIAM ODOM, DIRECTOR OF THE NATIONAL SECURITY AGENCY, PRESENTED AN EXCELLENT, INSIGHTFUL ANALYSIS OF THIS ISSUE ENTITLED, "THE IMPLICATIONS OF ACTIVE DEFENSE OF NATO FOR SOVIET MILITARY STRATEGY," TO THE EUROPEAN AMERICAN INSTITUTE FOR SECURITY RESEARCH WORKSHOP IN NOVEMBER OF 1984. I WOULD LIKE TO OFFER A COPY OF THAT PAPER TO THE COMMITTEE FOR INCLUSION IN THE RECORD.

IN REFLECTING ON THIS VERY BRIEF DISCUSSION OF THE PROMISE OFFERED BY THE STRATEGIC DEFENSE INITIATIVE TO TRULY ENHANCE DETERRENCE AND THE ROLE PLAYED BOTH IN THE PAST AND NOW BY OUR ALLIES, I SUBMIT THAT THERE IS NO SUBSTANCE TO CHARGES THAT THE SDI THREATENS TO "DECOUPLE" THE UNITED STATES FROM THE SECURITY OF OUR ALLIES, OR CREATE A 21ST CENTURY "FORTRESS AMERICA." THE PRESIDENT ENVISIONS DEFENSE FOR BOTH AMERICANS AND OUR ALLIES. THE BASIS FOR BOTH U.S. AND ALLIED SECURITY WILL BE ONE AND THE SAME - AS IT HAS HISTORICALLY BEEN.

TURNING TO THE STEPS TAKEN BY SECRETARY WEINBERGER INVITING ALLIES TO PARTICIPATE IN THE PROGRAM, WE SAW CONSIDERABLE SCIENTIFIC AND TECHNICAL EXPERTISE AMONGST OUR ALLIES IN THEIR SCIENTIFIC AND INDUSTRIAL COMMUNITIES. CERTAIN ALLIED CONTRIBUTIONS COULD REDUCE BOTH THE SCHEDULE AND THE COST OF THE SDI RESEARCH PROGRAM. BEYOND THE IMPORTANT TECHNICAL CONTRIBUTIONS WHICH ALLIED PARTICIPATION MAY MAKE, WE BELIEVE THAT THEIR INVOLVEMENT WILL CERTAINLY LEAD TO A MORE IN-DEPTH UNDERSTANDING OF THE PROGRAM AND THE TECHNICAL BASIS FOR DEFENSE AS WELL AS ITS MILITARY BASIS. THIS UNDERSTANDING WILL BE A VITAL UNDERPINNING OF A FUTURE DECISION TO PROCEED INTO DEVELOPMENT. WE HAVE PLEDGED TO MAKE THAT FUTURE DECISION IN FULL CONSULTATION WITH OUR ALLIES AS WELL AS TO ATTEMPT NEGOTIATIONS WITH THE SOVIETS. MOREOVER, ALLIED PARTICIPATION WILL SPARK A LATENT SYNERGISM NOT ONLY IN DEFENSE AGAINST BALLISTIC MISSILES, BUT ALSO IN THE CONVENTIONAL ARMS ARENA.

THERE ARE MANY UNIQUE AND IMPORTANT TECHNICAL CAPABILITES THAT OUR ALLIES CAN BRING TO THE SDI RESEARCH EFFORTS - IN SOME CASES, IT MAY BE A MEANINGFUL TECHNOLOGY BASE IN CERTAIN AREAS, FOR EXAMPLE, THE SDI DIRECTED ENERGY RESEARCH PROGRAM. IN THIS AREA, SEVERAL OF OUR ALLIES HAVE ONGOING, ADVANCED PROGRAMS INVOLVING SMALL, BUT VERY SPECIFIC LASER AND PARTICLE BEAM RESEARCH WHICH COULD COMPLEMENT EFFORTS UNDERWAY IN THE U.S. IN THE FIELD OF OPTICS, SPECIALIZED HIGH QUALITY MATERIALS AND ADVANCED CONSTRUCTION TECHNIQUES ARE AREAS OF RESEARCH EXPERTISE FOUND IN SEVERAL ALLIED NATIONS. THERE ARE ALSO ALLIES WHO HAVE

EXTENSIVE PROGRAMS INVOLVING GALLIUM ARSENIDE RESEARCH, COMPUTER RESEARCH, COMPOSITE MATERIALS, ELECTROMAGNETIC LAUNCHERS, AND INFRARED SENSORS AS WELL.

WHILE THE ATTRACTION OF A DIFFERENT ARRAY OF SCIENTIFIC TALENT IS A POWERFUL FACTOR FOR OUR INTEREST, THERE ARE ALSO OTHERS - SUCH AS ACCESS TO SPECIAL FACILITIES OR TEAMS OF RESEARCHERS WITH UNIQUE EXPERIENCE, OR THAT HAVE BROUGHT SPECIAL TECHNOLOGY PARTWAY AND TAKING IT FURTHER MAY BE USEFUL FOR THE SDI. IN THE CLIMATE OF LIMITED RESOURCES, EVERY EFFORT MUST BE MADE TO DERIVE MAXIMUM BENEFIT FROM OUR DEFENSE DOLLAR. IF CERTAIN JOBS CAN BE DONE MORE EFFECTIVELY, AT LESS COST, OR MORE QUICKLY, IN THE HANDS OF OUR ALLIES, THEN IT IS INCUMBENT ON US AS RESPONSIBLE MANAGERS TO SERIOUSLY CONSIDER SUCH EXECUTION.

TO DERIVE THE GREATEST BENEFIT FROM ALLIED EXPERTISE THROUGHOUT THE VARIOUS SDI RESEARCH AREAS AND SATISFY THE NEED TO KEEP THEM AS FULLY INFORMED AS POSSIBLE OF THE DESIRABILITY OF DEFENSE-ORIENTED FORCES, THE U.S. SHOULD PROCEED TOWARD DEVELOPING A MEANINGFUL ALLIED ROLE IN SDI RESEARCH - ONE CONSISTENT WITH OUR TECHNICAL REQUIREMENTS, LAWS, REGULATIONS, AND INTERNATIONAL OBLIGATIONS.

AS THE SDI PROGRAM IS MOVING AHEAD AT A VERY RAPID PACE, OUR NEAR TERM GOAL IS TO GIVE OUR ALLIES EARLY OPPORTUNITIES TO PARTICIPATE IN SDI RESEARCH. WE INITIATED THIS PROCESS WITH THE

SECRETARY'S INVITATION. IT WAS SENT TO 18 OF OUR ALLIES - AUSTRALIA, BELGIUM, CANADA, DENMARK, THE FEDERAL REPUBLIC OF GERMANY, FRANCE, GREECE, ISRAEL, ITALY, JAPAN, KOREA, LUXEMBOURG, NETHERLANDS, NORWAY, PORTUGAL, SPAIN, TURKEY, AND THE UNITED KINGDOM. THE RESULT HAS BEEN A SERIES OF CONTINUING BILATERAL DISCUSSIONS WITH MANY OF THE COUNTRIES; BRIEFINGS TO THEIR DELEGATIONS WHO COME TO WASHINGTON; ARRANGING VISITS FOR THESE GROUPS TO OUR LABORATORIES AND CONTRACTOR FACILITIES; AND, IN SOME CASES, A VISIT FROM AN SDIO TECHNICAL TEAM TO THEIR COUNTRY. THE OBJECT OF THESE DIALOGUES HAS BEEN TO ADDRESS THE VARIOUS PROCEDURAL CONCERNS AND TO IDENTIFY AREAS OF SDI RESEARCH FOR POSSIBLE PARTICIPATION, CONSISTENT WITH U.S. LAW, SECURITY INTERESTS IN PROTECTING SENSITIVE TECHNOLOGY, AND OUR OBLIGATIONS UNDER THE ABM TREATY.

IN THESE DISCUSSIONS, WE HAVE INDICATED OUR FLEXIBILITY WITH REGARD TO ENABLING MECHANISMS. IN OTHER WORDS, THERE ARE A NUMBER OF WAYS THAT THE ALLIES COULD PARTICIPATE IN THE PROGRAM. SOME ALLIES ARE INTERESTED IN CONCLUDING NEW GOVERNMENT-TO-GOVERNMENT OVERARCHING OR FRAMEWORK AGREEMENTS WHICH WOULD PROVIDE A COMPREHENSIVE BASIS FOR THEIR COUNTRY'S INVOLVEMENT IN THE STRATEGIC DEFENSE INITIATIVE RESEARCH PROGRAM. PROCEEDING ALONG THESE LINES ALLOWS US TO SORT OUT THE ISSUES OF PRINCIPAL CONCERN TO THE ALLIES AND OURSELVES REGARDING THEIR PARTICIPATION. MATTERS SUCH AS ENSURING FAIR PROPERTY RIGHTS, PROVIDING PROPER ACCESS TO SDI INFORMATION, MAINTAINING STRICT INDUSTRIAL AND TECHNICAL SECURITY, AND ALLOWING FAIR COMPETITION WITH U.S.

INDUSTRY ARE BUT A FEW OF THE CONCERNS FOREMOST IN ALL OUR MINDS. WHETHER OR NOT WE CONCLUDE SUCH OVERARCHING AGREEMENTS, SPECIFIC RESEARCH PROJECTS WILL REQUIRE SEPARATE IMPLEMENTING ARRANGEMENTS. THESE COULD TAKE A VARIETY OF FORMS. ONE COULD BE AN ARRANGEMENT WHEREBY WE WOULD ENTER INTO AN AGREEMENT FOR COOPERATIVE RESEARCH IN WHICH BOTH PARTIES WOULD SHARE IN COSTS. THE IMPLEMENTING VEHICLE IN THIS CASE WOULD BE GOVERNMENT-TO-GOVERNMENT MEMORANDUM OF AGREEMENT. SUCH COOPERATIVE ARRANGEMENTS CAN BE PARTICULARLY ATTRACTIVE AND HAVE POTENTIAL SINCE THERE ARE MANY CASES WHERE THE U.S. AND AN ALLY ARE BOTH WORKING IN COMPARABLE AREAS.

A MORE COMMON FORM WOULD BE A CONTRACT AWARDED FROM THE SDIO (OR ITS AGENT) TO AN ALLIED GOVERNMENT, OR GOVERNMENT AGENCY, SOMETIMES ON A SOLE SOURCE BASIS, BUT MORE NORMALLY ON A COMPETITIVE BASIS. THE ALLIED GOVERNMENT OR GOVERNMENT AGENCY MIGHT, IN TURN, SUB-CONTRACT TO ITS INDUSTRY OR LABORATORIES. ALLIED GOVERNMENTS, IN THIS INSTANCE, WOULD PLAY A MANAGEMENT, OR INTEGRATION ROLE. WE COULD ALSO AWARD CONTRACTS DIRECTLY TO ALLIED INDUSTRY, AGAIN ON A SOLE SOURCE OR COMPETITIVE BASIS AS APPROPRIATE. FINALLY, WE BELIEVE THERE IS CONSIDERABLE LATITUDE FOR ALLIED LABORATORIES AND INDUSTRY TO WORK DIRECTLY WITH U.S. CONCERNS ON SDI CONTRACTS. WE HAVE ALREADY SEEN A GREAT DEAL OF INTEREST IN ALL THESE POSSIBILITES - FROM ALLIES AND FROM OUR OWN INDUSTRY.

IT IS IMPORTANT TO POINT OUT THAT THE FUNDAMENTAL BASIS FOR ALLIED PARTICIPATION MUST BE TECHNICAL MERIT. WE HAVE MADE CLEAR TO ALLIES THAT THERE CAN BE NO GUARANTEE OF A CERTAIN LEVEL OF EFFORT.

I SHOULD PERHAPS INDICATE ONE FINAL POSSIBILITY. ALLIES, PARTICULARLY THOSE WITH MORE LIMITED NATIONAL RESEARCH CAPABILITIES, COULD BE INVITED TO SEND SELECTED AND APPROPRIATELY CLEARED PERSONNEL WHO CAN MAKE REAL CONTRIBUTIONS, TO JOIN SPECIFIED U.S. RESEARCH TEAMS IN A SCIENTIFIC EXCHANGE PROGRAM. AS YOU KNOW, DOD ALREADY HAS A NUMBER OF SUCH EXCHANGE PROGRAMS IN PLACE. WHATEVER THE ARRANGEMENT, WE ARE TAKING VIGOROUS STEPS TO ASSURE THE SECURITY OF THE PROGRAM AND TO SAFEGUARD ALL SENSITIVE INFORMATION AND TECHNOLOGIES. THIS IS FUNDAMENTAL TO ANY AGREEMENTS THAT MAY BE REACHED.

BRIEFLY, I HAVE TRIED TO OUTLINE A FEW OF THE PERTINENT POINTS WITH RESPECT TO ALLIED PARTICIPATION IN THE STRATEGIC DEFENSE INITIATIVE. I WOULD EMPHASIZE THAT U.S. AND ALLIED SECURITY REMAINS INDIVISIBLE. THE SDI PROGRAM IS DESIGNED TO ENHANCE ALLIED SECURITY AS WELL AS U.S. SECURITY. WE WILL CONTINUE TO WORK CLOSELY WITH OUR ALLIES TO ENSURE THAT, AS RESEARCH PROGRESSES, ALLIED VIEWS ARE CAREFULLY CONSIDERED AND THEY ARE GIVEN THE CHANCE TO TAKE PART. WE HAVE MADE A SERIOUS COMMITMENT TO CONSULT WITH OUR ALLIES, AND SUCH CONSULTATIONS WILL PRECEDE ANY STEPS TAKEN RELATIVE TO THE SDI RESEARCH PROGRAM WHICH MAY AFFECT OUR ALLIES.

I CANNOT OVERSTATE MY COMMITMENT TO THIS CRUCIAL PROGRAM AND MY CONVICTION THAT IT IS OF THE UTMOST IMPORTANCE TO OUR NATION AND OUR ALLIES. IT CLEARLY OFFERS THE PROMISE OF A SAFER, MORE SECURE WORLD, HERETOFORE ONLY A DREAM TO A GENERATION. THE SDI IS THE KEY TO MAKE THAT DREAM A REALITY. AGAIN, I THANK YOU FOR THE OPPORTUNITY TO APPEAR TODAY AND WELCOME YOUR QUESTIONS.

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THE IMPLICATIONS OF ACTIVE DEFENSE OF NATO FOR SOVIET MILITARY STRATEGY

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THE IMPLICATIONS OF ACTIVE DEFENSE OF NATO FOR SOVIET MILITARY STRATEGY

A certain temerity is required for a Western analyst to address this topic. To do it properly, he should have a fairly accurate knowledge of Soviet military strategy and war plans. He should know a great deal about Soviet missiles and aviation, particularly technical characteristics of their performance. Finally, he needs to judge quantitative interactions between NATO and Soviet forces with and without active defenses for NATO. Clearly such knowledge is not available in the fullness we would like it, and what is available is not adequate for final judgments.

We can, nonetheless, determine whether Soviet military planners are likely to see active defense of NATO as having little significance for the Soviet Union -- a trivial factor in face of offensive forces -- or whether it would compel them to make major changes and throw doubt on their offensive strategy for war.

The approach here will be to dwell initially on Soviet strategy, doctrine, and weapons and then to ask what differences defenses might make in the calculations of Soviet planners. The aim is modest: to demonstrate that active defense is not trivial for Soviet strategy, that it could alter significantly the Soviet estimate of the prospects for a successful attack on NATO.

SOVIET OFFENSIVE STRATEGY FOR EUROPE

We are at present witnessing a second major change since WW II in Soviet strategy and doctrine for offensive warfare. The first, inspired by what Soviet military planners call the "revolution in military affairs," was marked by Sokolovsky's 1962 volume, Military Strategy. It took account of three new technologies and the implications of each for the nature of future war. Rocketry, nuclear weapons, and cybernetics brought such dramatic change to the character of war, in the Soviet view, that a virtual revolution was required in Soviet doctrine, strategy, and force planning. The scope of warfare would be global, massive firepower could be delivered at intercontinental and full theater ranges in minutes and hours, and the requirements for maneuver with both fires and forces would be enormous, on a scale heretofore inconceivable.

The next 20 years saw the Soviet armed forces expand qualitatively and quantitatively in unprecedented degrees. Until the late 1970s, Soviet open writings gave the impression that a conflict in Europe would involve nuclear weapons very early. Much Western analysis either emphasized that about Soviet doctrine or insisted that selective and limited use were technically unfeasible, thus reinforcing this public view of the Soviet posture. As Trulock and Gouré make clear in another chapter in this volume, Soviet military circles already in the late 1960s were exploring extensively the prospects for selective and purposeful use of nuclear weapons to support military operations within strong political guidance. Their case is based on a great deal of recently available Soviet classified materials. Many of their conclusions have long been supportable by inferences from open sources and Soviet force developments, and a number of authors have reached those conclusions but in face of much skepticism and criticism. Trulock and Gouré will be far more difficult for serious skeptics to doubt. For our purposes here, however, the important insight is that the so-called 'revolution in military affairs" announced by the Soviet military in 1950s and 1960s had as its logical development the trend away from massive and indiscriminant use of nuclear weapons toward discrete targeting as part of Soviet "combined arms doctrine."

That trend has not ended, but it is competing with a parallel second postwar shift in Soviet military affairs. Once again, a triad of new technologies are affecting Soviet views of changes in military affairs: microcircuitry, directed energy systems, and genetic engineering. Marshal Ogarkov seems to have been a key figure in leading the new developments because they are coincidental with his emergence as Chief of the General Staff in 1977. In an interview with Red Star,[1] Ogarkov declared that new weapons technologies have altered the character of war sufficiently that a global strategic conflict is conceivable in which nuclear weapons would not be used. The effectiveness of advanced nonnuclear weapons could make it unprofitable to resort to nuclear weapons.

Microcircuitry and directed energy systems are the technologies that make "smart munitions" possible as well as deliverable at long ranges with great accuracies. Genetic engineering is far less certain in its possible military applications; it may prove to have few or none, but it seems to attract great Soviet attention in scientific circles and international fora. It is not at once obvious why these new technologies have created such a dramatic sense of change in the USSR. Perhaps it is fear of the West's lead in their applications. Perhaps it is the significance for Soviet industry. Perhaps it is frustration at having built a large military force to cope with the 1950s triad of technological concerns only to see them possibly declining in relative importance. It is probably all of these, and we can better understand their reactions if we think about the Soviet solution to the problems they saw created by nuclear weapons and rocketry.

Rocketry and long-range aviation permit unlimited depth for fire support. Nuclear weapons permit great destruction of massed forces. These two realities formed the basis for Soviet doctrine and force development. First, to make their own forces less vulnerable to nuclear weapons, they planned to spread them out as evenly as possible over the entire depth of their own territory. They did this by "echelonment." To achieve the necessary mass for penetrations of the enemy's defenses, they planned on a high speed attack, all echelons rolling forward rapidly. That would cause combat power to pile up at the line of contact where the enemy would be reluctant to use nuclear weapons. As the first echelons found weak points, subsequent echelons could be guided through for deep penetrations.

Second, they had to develop a means of fire support that could attack the full depth of the enemy's rear. The purpose of this support would be to destroy first of all the enemy's nuclear means, then his command and control, and finally, his reserve forces, or at least to make it difficult for them to be brought to bear against Soviet penetrating forces.

The beauty of this doctrine, as John Erickson[2] has pointed out, is that it permits or requires a "combined arms" operation which can be conducted at both the nuclear and nonnuclear levels without significant change. The doctrine without the means to implement it, however, would leave the beauty unrealized, a point emphasized by Trulock and Gouré. New technologies actually affect the character of war when they are deployed in quantitatives that can make a difference. The set of Soviet military programs carried through from the 1950s to the mid-1970s are much easier to understand when viewed in this doctrinal context. The maneuver forces are fairly well known -- a large inventory of tanks, infantry fighting vehicles, artillery, combat engineer equipment, mobile air defenses, signal means, and logistical means. The fire support forces are more important to our concerns in this essay.

Stephen Meyer has provided us with the most comprehensive open source study of those forces available.[3] From his analysis and his catalogue of Soviet ICBM, IRBM, SLBM, SLCM, and aircraft programs,[4] we can see that the 1950s' "revolution in military affairs" inspired fire support programs that promised coverage to the full depth of the theater of war. Similar evidence of

Soviet intercontinental nuclear forces can be found in the official publication of the Department of Defense, Soviet Military Power.[5] In this first set of programs, however, the quality of the systems was poor in accuracy, speed of operation, and a number of other performance characteristics. Nuclear warheads had to be large to offset inaccuracy.

By the late 1970s, accuracy and other problems were being overcome, but the quantitatives of the improved systems were still small. Not surprisingly, a massive modernization program was set in progress and continues today. In almost every case, there were no essentially new systems but only qualitatively better systems. SS-20s appeared to cover SS-4 and SS-5 missions; SCALEBOARD, SCUD, and FROGs were being replaced by SS-22, SS-23, and SS-21 models. A similar pattern is found in aviation and SLBMs. The single rather new theater development is the cruise missile, and even it is not new in principle for Soviet forces. New guidance and propulsion technologies simply give cruise missiles possibilities wholly unknown in the earliest models found in Soviet inventories.

In ICBMs, of course, we are seeing the early stages of Soviet programs for mobile ICBMs. In silo based systems we see modernization but not a force expansion. The expansion appears to be coming in mobiles and variations of cruise missile launchers -- air, sea, land.

The important point to draw from these data is that the first period of Soviet force building, up to the late 1970s, involved a sizing of Soviet forces for fire support. While we do not know in all the particulars of how Soviet planners arrived at the answer to "How much is enough?", we can make some rough inferences on that account. Stephen Meyer offers a rather compelling analysis of Soviet force sizing. He uses a couple of Soviet analytical models, takes account of their professed target priorities, and concludes that the full set of NATO targets could be covered by Soviet theater nuclear forces before the SS-20 was deployed.[6] This force sizing, of course, was done against a NATO which had no active defenses, except air defense, and with very little passive defense.

The sizing of intercontinental forces has not been analyzed in the same way in open sources, but unless the Soviet approach to the task is systemically different from sizing theater forces, one rough inference seems justified: the ICBM forces in silos have levelled off in numbers. The same is probably true for SLBMs and bombers but much less certain. ICBM expansion will apparently come in mobiles. This may seem puzzling, but from a Soviet doctrinal viewpoint it is not. Soviet planners remain obsessed with the "initial period" of a war. Because it is judged to be decisive for the eventual outcome of the war, the General Staff clearly wants to dominate that period. Their terminology for this outcome is achieving a radical shift of the "correlation of military forces" in favor of the USSR. There will be subsequent periods, perhaps lasting months and years, but the initial period can well cast the die for the final outcome. The level of strategic nuclear forces reached in the late 1970s, therefore, probably equals what the Soviet planners believed is necessary for a decisive shift in the "correlation of military forces" in the "initial period." Mobile ICBMs and other new systems -- possibly cruise missiles and bombers -- are quite naturally the arsenal of deep fire support for the subsequent periods of a global war. Finally, it should be noted that this sizing of strategic forces was probably based on no strategic defense in the U.S., active or passive.

Precisely where the present modernization programs will take Soviet force structure is not entirely clear, but if we keep in mind employment doctrines for both maneuver forces and fire support forces, we get some interesting insights. Marshal Ogarkov has emphasized again and again the need for a "theater strategic operation," an operation composed of multiple fronts and encompassing continuous combat to the full depth of a "theater of military activities."[7] In his articulation of this concept, we get a sense of an offensive that is designed to seize Western Europe in a much shorter time, weeks, not months. Such an operation clearly must be supported by highly coordinated fires affecting all adversary forces that could be brought to bear in the theater. In light of the U.S. commitment to NATO of ten divisions in ten days, it is obvious that Soviet targeting would include trying to prevent that reinforcement. Thus, Soviet strategic target sets may not include just U.S. ICBM fields and economic targets. In the "initial period" in Europe, U.S. land forces are critical variables in "correlation of military forces." Many targets in the U.S. could be ignored for a few days or weeks; not so land forces enroute to Europe.

These points about Soviet targeting and force sizing are essential to understand if we are to appreciate the impact of active defenses in NATO, including the U.S., in initial exchanges. The dynamic dimension is also important. The Soviet choice of a target set will change as the war scenario varies. During a conventional phase of the war, Soviet conventional means will seek to degrade NATO's nuclear forces. Thus, the active and passive defense of NATO nuclear systems will be significant for the subsequent nuclear phase. For certain contexts the Soviet planner will deal with calculations of TNF alone, but he will always put them back in the context of "combined arms" doctrine and a war extending beyond an initial period.

SOVIET STRATEGIC DEFENSES

Soviet offensive forces have not grown alone without a defensive counterpart program. The massive Soviet high-altitude air defense system has always puzzled Western analysts who assume an objective inescapability about the nature of "mutual vulnerability." Much the same can be said about Soviet civil defense. But with the emerging low-altitude air defense deployment, the SA-10 and the look-down-shoot-down fighter interceptor capability, it is difficult to remain puzzled: the Soviet leadership simply takes strategic defense seriously, not only active, but also passive defenses. Does it make sense to deploy all these defenses without an ABM cap over them? That is difficult to answer without a way to calculate the significance of passive defense, especially dispersal and sheltering. Because the

U.S. strategic force level has remained more or less static for several years, while Soviet passive and active defenses have grown steadily, it has to be assumed that some degradation in U.S. damage expectancies has occurred. And it is also important to note that the Moscow ABM system, if it proves even marginally effective, covers many high-value targets: command and control, political leadership, and military industrial.

There are some signs that the USSR might indeed put an ABM, as well as an ATBM, cap on homeland strategic defense. Sayre Stevens draws this conclusion in his analysis of recent reports of the Soviet SA-X-12 having an ATBM and possibly an ABM capability, or at least the potential for such a capability.[8] Most troublesome is the mobile nature of upgraded SAMs for ATBM and ABM. Not only would they be more difficult to locate and suppress, but they would also be difficult to call a violation of the ABM treaty, particularly if Soviet authorities refused to admit the ABM potential. "Creepout" is probably a much greater threat on the Soviet side than "breakout" from the ABM treaty.

The central conclusion that we should draw from a look at Soviet strategic defensive force building is threefold. First, Soviet military planners take defense seriously, very seriously, enough so that they allocate large resources to defense programs, both active and passive. Given the Soviet record for calculation in every other aspect of force building, many calculations must suggest to them a compelling case, not only for strategic defense, but also for determining what defenses to deploy. Second, active defenses are not considered alone. They are part of an overall concept of defense, including passive means and active systems, as well as degradation of NATO's offensive nuclear systems with conventional "combined arms" operations. Third, strategic defense is part of any Soviet calculation of the overall correlation of military forces. Today that calculation includes only air defense in the list of NATO "active" defense measures. Any change in the defensive posture of the NATO states is bound to affect Soviet calculations. If they take defense seriously for themselves, they must take it seriously for their adversaries, probably more seriously.

WHAT DIFFERENCE DEFENSE MIGHT MAKE

If we assume the position of Soviet planners who hold the foregoing view of future war, required forces, and war plans, and if we ask what difference active defenses are likely to make, the first question we probably would want to answer is whether such defenses could really make a big difference. Are they something that would significantly affect our offensive strategy and force levels? And, of course, we would want to know when such defenses could be deployed. If it is not until the next century, then the significance will be trivial in the remainder of this century, leaving us quite a long planning horizon.

-- Soviet TNF Capabilities Inventory

From the foregoing analysis of Soviet doctrine for general war, particularly how it would unfold in Europe, we can assume that Soviet planners have sized their theater nuclear forces to deal with the present target set in NATO. According to Meyer, this is "about 280 individual targets, of which 100 could be regarded as time-urgent, with 50 of the latter being hard point targets."[9] Taking into account the kind of target and the reliability of the systems, the early 1970s Soviet TNF inventory consisted of 472 SS-4s, 90 SS-5s and 120 SS-11s (ICBMs used for theater missions). The force provided between 353 and 472 deliverable warheads in light of reliability factors. When attack requirements for the different kinds of targets are included, and when aviation is also included, Meyer's analysis suggests that the introduction of the SS-20s has not changed the damage expectancies for Soviet planners against NATO. Rather they have made complicated attacks easier, improved planners' confidence, provided margins of forces so that a preemptive strike would not have the effect of consuming the entire Soviet TNF inventory, and allowed reduction of collateral damage. Depending on reliability, between 420 and 639 SS-20 warheads on SS-20s are available (this assumes 240 SS-20 targeted against Europe). While Soviet planners have some margin in numbers of warheads, even the new systems do not give them four or five times the number of warheads needed for a full coverage strike. Of course, the continuing growth of the SS-20 force, including reloads, means this is not a permanent condition. It cannot, however, change overnight or cheaply.

-- Western Active Defense Technology and Applications

Picking up Ballistic Missile Defense,[10] Soviet planners could get a fairly clear picture of available technologies for deployment in this century, and they could determine what applications we believe are most effective and most feasible. As the chapter by Stephen Weiner asserts, "Given the current state of technology, reentry BMD systems have the lowest technical risk. . . ."[11] In other words, endoatmospheric systems are feasible, probably well within NATO's capability to deploy in the 1990s. These systems would, therefore, worry the Soviet planner most.

Our Soviet planner would also note that Weiner concludes that "The job of defending redundant hard targets such as missile silos is much easier than defending cities. . . ."[12] In other words, he would be very interested in what NATO chooses to defend actively because the targeting problem could inherently be easier or harder. A NATO effort to defend cities or other broad area targets would not likely disturb the Soviet planner deeply. Carefully selected military capabilities which are critical to NATO military operations, however, would galvanize his attention.

Ashton Carter's study of BMD applications[13] provides a thorough review of the various kinds of BMD systems used in a variety of defense missions. For our Soviet planner, his most important observation is that "Virtually everyone concedes that BMDs can be made that would force the attacker to double up -- a price of two RVs -- to destroy a defended target even if the attacking RVs were perfectly accurate and reliable. Within the two to eight range there is lively debate."[14] What does it take to force the attacker to double up, that is, use two RVs per target? "If the defense only succeeds in making its single intercept more often than it fails, the offense will conclude that it make better use of RVs by targeting two RVs at a lesser number of defended aimpoints than by targeting one RV at each of a larger number."[15] This is demonstrated by assuming that the attacker has 1,000 RVs to use against 1,000 targets, each defended by BMD. If the BMD succeeds 51% of the time, a one-on-one attack of all 1,000 targets will achieve at best 490 kills. A two-on-one attack will kill 500. Thus, sober calculation leads to the targeting of only 500.

The Soviet planner would see at once that a BMD system is technologically feasible today which would force him to resort to two-on-one targeting at a minimum. Of course, he already knows this, from his own programs, but now he can see NATO attention possibly turning to a serious review of these technical insights.

We are taking an extremely conservative view of technology in this instance. We are only considering one layer of defense, terminal defense of militarily significant targets. We are not betting on high risk or future technologies but rather things that could be fielded in the next decade or less, probably a lot sooner. Adding a second layer of defense to deal with the "mid course" of ballistic missiles is also feasible with nuclear warheads in the interceptors, and in light of the Army's recent test results with a nonnuclear shot at an incoming RV, a nonnuclear overlay defense can no longer be relegated to the next century. Once we move to a layered defense, of course, we are able to talk about charging much higher attack prices, three- to eight-for-one, perhaps more.

-- Soviet Modelling for TNF Requirements

Next, the Soviet planner would want to explore the sensitivity of his own sizing requirements to possible NATO active defenders. Soviet planners have shown a strong affinity for analytic modelling in military affairs. In fact, the Soviet military has been alleged by some to have more game theorists than any other army in the world. Stephen Meyer has examined a couple of analytic models which appeared in Soviet closed writings, models which inspired criticism and debate that reveal a great deal about the variables Soviet military planners take most seriously in force planning.[16]

The first is called the model for Correlation of Nuclear Forces. Developed in the 1960s, it used variables for EMT (equivalent megatonnage), penetration probabilities for both Soviet and enemy delivery systems, and survivability for both Soviet and enemy systems. In the ensuing closed Soviet discussions,[17] criticism focused largely on the variables in the model, the extent to which they could be determined empirically, hidden complexities, and so forth. But it did not dismiss such modelling. Rather the attempt was to improve it.

The model formula was:

$$C=C_0 \frac{\sum \sqrt[3]{U_i}^{2}\cdot P_i \cdot S_i}{\sum \sqrt[3]{U_j}^{2}\, P_j\, S_j}$$

where:

C_o = the initial correlation of nuclear forces defined as the total deployed EMT of Soviet nuclear forces divided by the total deployed EMT of enemy nuclear forces.

U_i; U_j = the fraction of Soviet megatonnage carried by a given type (i) of delivery system; the fraction of enemy megatonnage carried by a given type (j) of delivery system.

P_i; P_j = the penetration of a given type (i) of Soviet delivery system; the penetration probability of a given type (j) of enemy delivery system.

S_i; S_j = the survivability probability of a given type (i) of Soviet delivery system; the survivability probability of a given type (j) of enemy delivery system.

The main variables, U, P, and S, are complex and require extensive empirical data and calculations if the model is to be used. For our purposes here, we merely need to be concerned with P_i, that is, the penetration of the Soviet delivery systems. The Soviet author let the Soviet side attack first, aiming first of all to destroy the enemy's TNF, but also other targets. The enemy then retaliates, requiring a second calculation, and yielding a value for C that represents "the relative potential of the two residual nuclear forces to destroy target arrays similar in composition and area."[18]

If we assume that such a set of calculations is made to yield some value for C in which no active defense (except present air defenses) exists in NATO and then repeat that calculation for the cases where NATO has active defense that will kill ballistic missile RVs, we will see the effect on a Soviet planner's calculation of the consequences of that deployment. All other things being equal, C will decline in direct proportion to the value of P_i, the probability of penetration, which is a function of NATO defenses. As P_i drops from 0.8 or 0.9 to the 0.3-0.5 range, C is roughly halved.

BMD systems which could charge a price of two-for-one instead of one-for-one, therefore, could lower the value of P_i by one-half for the target set such a system defends.

As Meyer points out, this model, presented by the Soviet author, I. Anureev, received much criticism by other Soviet analysts. "It did not provide either a relative or absolute measure of the effect of a preemptive nuclear strike on the enemy, or friendly capabilities. In other words, a residual of 5 to 1 might still leave the enemy sufficient TNF to annihilate a major portion of Soviet ground forces and logistics networks."[19]

A few years later, a model designed to meet most of the criticisms was introduced. N. Zubkov's "Control Effectiveness Model" encompasses "the capabilities of reconnaissance, target acquisition, C^3, command decision-making, crew responsiveness and weapons readiness."[20] The formula for this concept is:

$$K = \frac{\sum m_i \cdot P_i \sqrt[3]{q_i^2}}{\sum n_i \sqrt[3]{q_i^2}}$$

where:

n_i = total number of enemy nuclear weapons of a given type (i).

q_i = the average nuclear yield of enemy nuclear weapons of a given type (i).

m_i = the number of enemy nuclear weapons of a given type (i) that can be detected by Soviet reconnaissance capabilities.

P_i = probability of destroying a given type (i) of enemy nuclear system prior to its launch given it is located by reconnaissance.

The value calculated for K is the expected fraction of the enemy's EMT that could be destroyed. Meyer demonstrated what it might have produced in the early 1970s when NATO had about 670 EMT available for TNF missions. Assuming Soviet preemptive strikes "catch 85% of NATO land-based aircraft on the ground and 100% of carrier-based aircraft, then K would be about 0.60, leaving a residual NATO capability of 270 EMT deliverable by remaining aircraft, Pershing IA and Polaris/Poseidon SLBMs."[21] The model also allows a planner to deal with periods of convention conflict in which nonnuclear systems could attack the adversary's nuclear systems, thus degrading his TNF before the nuclear phase. But it is a model only for analyzing preemptive strikes, and it will lead to choosing a force that maximizes effectiveness for that mission.

In our considerations here, however, that is precisely what we want to examine. What would NATO active defense imply to the Soviet planner? How would he see its effect on his calculations of his force needs?

Two points are fairly clear in this regard. First, the value of P_i will be affected by NATO active defense. The example calculation offered by Meyer for the early 1970s would have come out considerably lower, approaching double the size of the remaining NATO EMT if a two-for-one price had been charged against the SS-5 strike.

Second, the value of m_i should attract our attention. Among other variables, the Control Effective Model is sensitive to reconnaissance. What Soviet recce cannot find, Soviet TNF cannot hit except by random chance. Mobile targets, therefore, become a problem if they cannot be found, and among the many scenarios a crisis period leading to war could take, the prospects for losing knowledge of locations are considerable. Active defenses could threaten some kinds of Soviet recce, particularly space-based intelligence acquisition systems, and of course they would threaten recce aircraft. As the value of m_i declines, the Soviet planner must find means and resources to compensate for it.

By no stretch of the imagination should we conclude that these two models for Soviet TNF sizing are the ones actually used today. They were, however, taken seriously in the 1970s, and they offer the best insight we have in open sources into how the Soviet planners think about the TNF problems, what variables they see as critical, and what kinds of forces such modelling encourages them to build. The Correlation of Nuclear Forces Model would have dictated a large aviation buildup because it did not give special significance to time-sensitive target sets. The Control Effectiveness Model encourages one to buy time-urgent forces, that is, ballistic missiles. Both models can be used and the insights for force-building from both can be compared and used to achieve a mix of purposes. In light of the subsequent SS-20 deployment, one is inclined to believe the Control Effectiveness Model had something to do with the Soviet decision to build a more capable IRBM before expanding and modernizing frontal aviation.

If we take the indications from the models that NATO active defense would create -- sharply declining values for both C and K, and if we assume, as Meyer did, that Soviet TNF has been sized for a more or less undefended NATO target set, then the Soviet planner will be impressed that he has a serious problem. The seriousness of it will be underscored if those NATO defenses are applied to NATO TNF and C^3 assets, not to cities and broad area targets. We see little interest on the Soviet side in a "countervalue" approach to using TNF. Rather Soviet planners are primarily concerned with military targets and even with minimizing collateral damage in light of their postwar interests in the economic prizes they hope to capture in Western Europe.

The answer to "what difference do active defenses make?" from the Soviet viewpoint, then, is "a lot." And the answer is derived from looking through the analytical spectacles of his analytical models, not ours.

WHAT CAN THE SOVIET PLANNER DO ABOUT ACTIVE DEFENSES?

The conventional wisdom has long been that the Soviet planner can easily overwhelm active defense by piling on more warheads. The foregoing analysis should raise strong doubts about that as either the only solution or an adequate solution.

First, he does not have the stockpiles of warheads to overwhelm even a terminal defense system except in limited points. To concentrate on some targets will mean he must give up others. Before he will do that, he will try to determine what that will mean for the overall campaign, including fire, strike, and maneuver forces, nuclear and nonnuclear. Recent Soviet public discussions of the U.S. Army's "air-land" battle doctrine indicates that Soviet military planners see an expanding array of deep targets and a changing operational environment requiring across-the-board modernization of their doctrine and forces. Major General I. Vorobyev sees precision guided munitions against deep targets as making the competition to gain the advantage in "fire" take precedence over some of the efforts to gain it in "maneuver."[22]

It would be easy to say that our Soviet planner simply has to double his TNF capability to neutralize active defenses in NATO. It is not that easy or cheap for him, however. He must worry about BMD improvements that drive the exchange prices much higher than two-for-one, and he must be concerned about degradation of his reconnaissance. This becomes particularly acute as a problem when he begins to worry about the many mobile deep fire systems that might hit his TNF with nonnuclear munitions. In other words, he understands that the European theater does not permit isolation of the combined arms combat from ballistic missile exchanges.

Another standard argument, that penetration aids and decoys could be used to neutralize the defense or degrade its capability significantly, is also not compelling. Our Soviet planner needs all the warheads he can get. He is unlikely to surrender throwweight capacity to penetration aids in the theater context. At least until he builds many, many more TNF systems, multiplying his throwweight manyfold, it does not make much sense.

Our Soviet planner would, if his models are any clue, also be concerned about passive defense, e.g., hardening of C^3, air fields, and nuclear storage. The variable, P_i, to be fully developed, would include some added value for hardness as well as for active defense. Thus, unless we also know that added value, we cannot know how much of what kinds of added offense would be needed to offset it, but it is not likely to be trivial.

It seems very conservative to infer, therefore, that our Soviet planner would have to buy several times his present level of TNF capability as well as try other means of attack. Eventually he might regain the present correlation of forces, but he could not do that overnight. It could easily take a decade or more. Buying 10-15 years of credible defense is not to be dismissed lightly. Permanent and timeless defenses -- or offenses -- are not real options. A ten-year interval in the changing context of military technologies and strategies is a long time.

Of course, there is always the issue of comparative costs. Will active defenses cost NATO more to deploy and maintain than it will cost the USSR to counter with offensive forces? In the present conditions of TNF balances, the conventional view, that defense costs a lot more, may not be valid. Particularly as the Soviet planner sees a variety of other technologies complicating his problems for both defense and offense, e.g., "smart" munitions, then calculations become more complex. The answer is far from obvious, and it may be the opposite of conventional wisdom.

An answer to the comparative cost question also would seem to have to take account of Soviet planners' willingness to buy active defense for themselves. If it is not worth it, why do Soviet planners buy active defense so massively? Air defenses in the USSR are enormous, and we see expansions still occurring. We see billions of rubles of investment in the Moscow ABM system, not to mention the large peripheral radars. For force developers whose resources are far more constrained than NATO's, these active defenses must mean a great deal. The obvious answer, although not very popular in the West, is that strategic defense really matters, that Western notions of unavoidable vulnerability are not sound.

ACTIVE DEFENSE FOR NORTH AMERICA

Thus far we have dealt largely with Soviet TNF for Europe, not with ICBMs, SLBMs, aviation, and cruise missiles against the

North American continent. Unfortunately, no Soviet analytical models for intercontinental exchanges are available to give us a purely Soviet perspective. A few observations are possible, however, that might reveal something of a Soviet perspective on that dimension of the active defense issue.

Air defenses clearly are feasible, but the U.S. and Canada do not possess anything like the Soviet air defense capability. This has been due to the lack of a large Soviet bomber threat. That condition is changing with the new BLACKJACK bomber. It has already changed insofar as Cuba's role in a general war. Cuban MIG-23 aircraft, over 40 in number today, create an air threat to the Southeastern U.S. A large part of U.S. ground forces for Europe come from that region. Soviet reinforcement of aviation based in Cuba could occur in a crisis, changing the situation radically.

Submarine launched cruise missiles, a threat now emerging, create another type of air defense problem up and down both the East and West Coasts of North America. While active defense against them would be expensive, it is certainly feasible.

Active defense against any of these threats would unavoidably have a significant impact on Soviet planners. It would put them back in their old box where an attack of any significance on the U.S. would have to be by ballistic missiles. Aviation and cruise missiles with nonnuclear weapons may be what Ogarkov had in mind when he spoke of a global war in which nuclear weapons are not used. ICBMs and SLBMs with nonnuclear warheads, even with great accuracies, do not promise much return on the investment. Some kinds of active defense, therefore, clearly would make a big difference to the Soviet planners.

BMD would make a difference, depending on what it defended. Were selective use of BMD applied to C^3 and means of force projection (that is, airlift, sealift, and general purpose forces destined for Europe), that could have a strong bearing on Soviet calculations of the force balances during a war in Europe. At present, when there is no BMD in the U.S., very limited Soviet strategic targeting could prevent the U.S. from projecting forces to Europe on the NATO schedules. The impact on what the Soviets call the "initial period" of a war would be great, possibly decisive.

The popular Western concern for intercontinental counterforce exchange calculations, even the obsession with them, prevents most Western analysts from considering other and more modest target sets. Yet from a Soviet "combined arms" perspective, they are very likely to think about them first. And, as Trulock and Gouré point out, there is growing evidence that in fact they do. Moreover, given their lesser confidence in the reliabilities of technology, they would be much less inclined to engage in large "spike" attacks against ICBM fields where some kind of failure could cause them to waste large parts of their costly and precious strategic forces. Trials with smaller sets of warheads would clearly be more in line with the Soviet bias. This becomes more compelling when we remember that Soviet planners are investing heavily in strategic defense, something that makes sense only if they believe they must ride out a large U.S. strike and survive with some military capabilities.

CONCLUSIONS

As admitted at the beginning of this essay, a full answer to the question of implications of active defense for Soviet strategy requires knowledge of Soviet war plans, weapons capabilities, and quantative force interactions that we do not have. We do see, however, enough of changing Soviet military doctrine and force structure to draw some fairly cogent inferences. The following set of inferences seem to stand out:

-- Because the Soviet planner has had a free ride with his TNF, NATO active defense deployments, even the most modest terminal defense systems, would have a large impact on him. Not only would he have to pay the increase in offensive forces for TNF, but other technologies and the changing nature of operations and tactics will interact with active defenses in Europe to create quite complex problems for him.

-- Active defenses in North America would not solve many of the problems Western analysts find with leakage and so forth, but for the Soviet planner, they would create two kinds of difficulties. Air defenses would preempt the free ride he hopes to get with bombers and cruise missiles. BMD, depending on what it defends, would complicate his planning for winning quickly in Europe. The Soviet planner shows little sign of being concerned with the same problems that concern many of the authors in the Carter and Schwartz volume. Soviet planners are not interested in destroying U.S. cities. They are interested in capturing Europe and probably the two other major contiguous theaters.

-- The deployment of active defenses for NATO, in the Soviet planner's mind, would presage many other things. First, it would be seen as the beginning of defense improvements that would lead to others, more effective, more troublesome. Second, it would reflect a different Western psychological attitude to modern warfare. The concept of mutual vulnerability, upon which Soviet negotiators and planners have traded without accepting for their own planning, could no longer be expected to constrain Western force development. That would be a dramatic change for both political and military leaders in the USSR.

-- The Soviet planner would be terribly worried about two other dimensions of competition. First, in R&D, where the West is strong, he would now be up against a new Western challenge. Second, the areas of competition would be spread, cause him to be faced with allocating his lesser resources to a greater variety of endeavors both in R&D and industrial production. The situation heretofore has allowed him to compete with the NATO states in offensive forces only, to proceed at his own pace in defense. Henceforth, he would have to divide his efforts for a two-front competition instead of one.

-- Finally, active defense (and passive defense) takes the military interaction into all the complexities of "combined arms" operations, especially in Europe. That is, we cannot separate them out the way we have so often done in dealing with calculations about strategic forces exchanges. Other variables, like reconnaissance, maneuver forces, and nonnuclear fire support and strikes, enter the equation, making many of the traditional Western analyses inadequate to deal with them.

In many ways, events have moved past NATO. Active defenses already play a big role for the USSR. The issue may not be whether they make a difference so much as whether or not the Alliance is going to act to improve its active and passive defense.

1. *Red Star*, May 9, 1984.

2. *The College Station Papers*, 2: "Soviet Combined Arms: Theory and Practice" (College Station: Center for Strategic Technology, Texas A&M University, 1980).

3. Stephen M. Meyer, "Soviet Theatre Nuclear Forces," *Adelphi Papers*, 187 and 188, Winter, 1983/84.

4. *Ibid*., No. 188, especially pp. 54-47.

5. See *Soviet Military Power*, pp. 19-39, in the 1984 edition.

6. See especially Meyer, No. 188, p. 26.

7. *Always Ready to Defend the Fatherland* (Moscow: 1982), pp. 33ff was the first full description of the concept of the "theater strategic operation," but Ogarkov mentions some aspect of attaining that capability in almost every public article.

8. See Sayre Stevens' essay on "The Soviet BMD Program" in *Ballistic Missile Defense*, Ashton B. Carter and David N. Schwartz, eds. (Wash, D.C.: The Brookings Institution, 1984), pp. 214-220.

9. Meyer, No. 188, p. 25.

10. Ashton Carter and David Schwartz, eds.

11. *Ibid*., Chapter 3.

12. *Ibid*., p. 97.

13. *Ibid*., Chapter 4.

14. *Ibid*., p. 112.

15. *Ibid*., p. 119.

16. Meyer, No. 187, pp. 34-44.

17. The discussions were in *Military Thought*, a Soviet classified journal which is available in Western libraries in parts of the serial.

18. Meyer, No. 187, p. 39.

19. *Ibid*., p. 41.

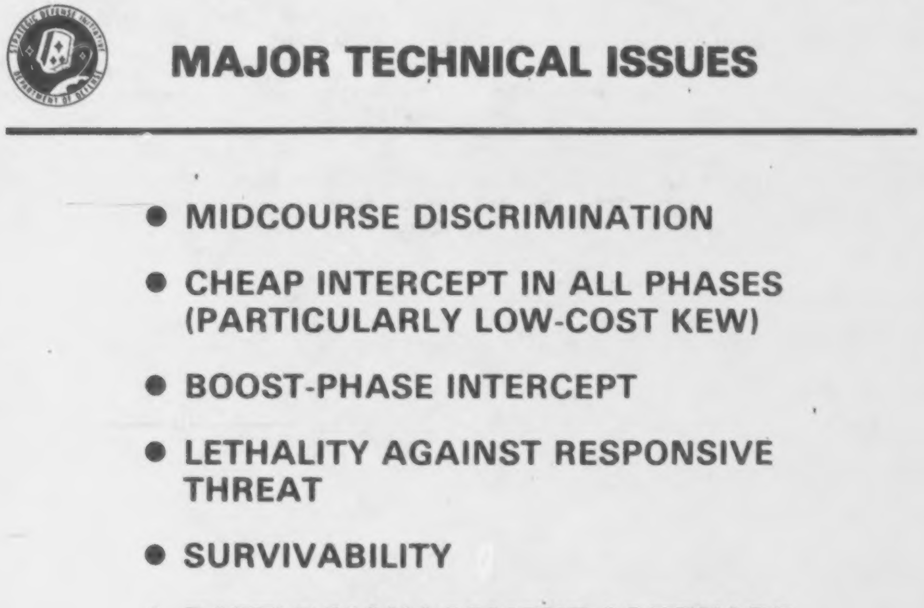
20. *Ibid*.

21. *Ibid*., p. 43.

22. *Red Star*, Sept. 15, 1984.

Mr. YONAS. What I would like to do is begin by putting the program in some perspective. Without that perspective, I think it is difficult to understand some of the other issues that you are discussing. So rather than attempt to justify the program, I would like to give you an understanding of the orientation of the program and then talk about the relationship of the program to our involvement with allies. And I would like to do that by first going through some illustrative material fairly rapidly. So could I have the first viewgraph.

[The chart follows:]



MAJOR TECHNICAL ISSUES

- MIDCOURSE DISCRIMINATION
- CHEAP INTERCEPT IN ALL PHASES (PARTICULARLY LOW-COST KEW)
- BOOST-PHASE INTERCEPT
- LETHALITY AGAINST RESPONSIVE THREAT
- SURVIVABILITY
- BATTLE MANAGEMENT SOFTWARE

Mr. YONAS. To begin with, in order to understand the orientation of the program and to see the nature of the research activity, one has to understand and view this not as a technological program to solve a well-defined technical problem, for instance, such as the Apollo project, where one had a well-defined goal and well-defined schedule and could identify a well-defined cost for the program.

The reason why this program has a very different nature is that we are attempting to provide a technological basis for a decision, a decision that has not been made, a decision to change the basis of deterrence from today's posture, which is reliant on threat of retaliation, to entering into a transition process that would rely increasingly on defense.

Now if one is to make such a transition, one has to understand not only the technological capabilities for the defense, but one has to also understand the technological capabilities for the offense. How might the offense respond? And in doing this, we are pursuing a program that is driven to a large extent—our defensive technological program is driven to a large extent by the postulated countermeasures. What is it that the Soviets can do, what is it the Soviets will do?

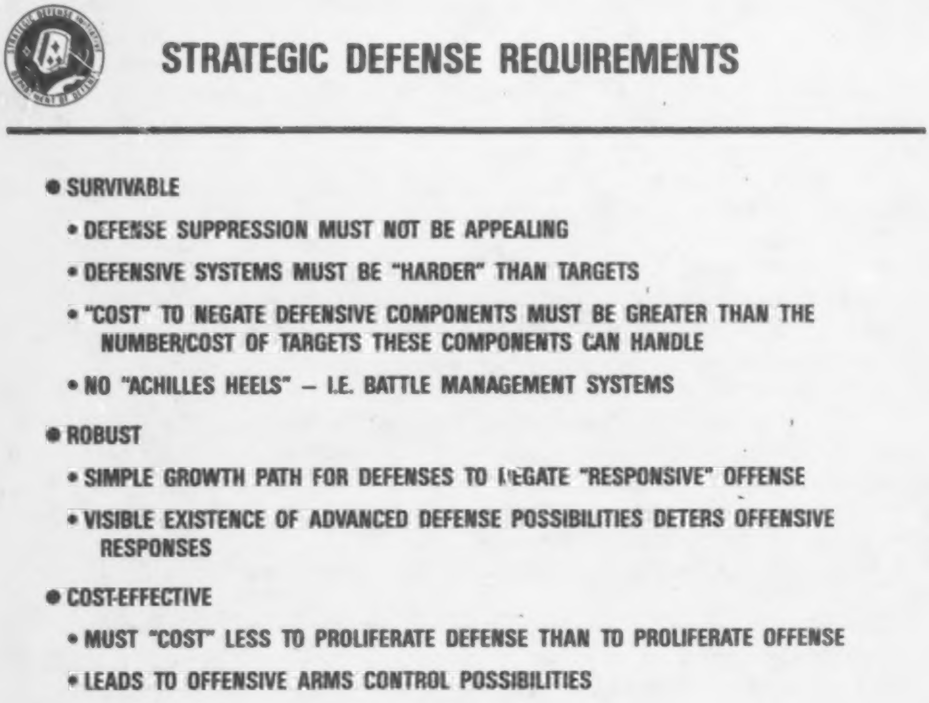
Now, in looking at the defensive technologies, we have to assume that the Soviets would present an opposition which would be based on the kinds of technologies which would be realistic in the future. We think these fall into two categories: Change their offense or attack their defense.

When you look at changing the offense, we have to understand the economic implications, the technological implications of changing the offense. Could they, in fact, change from their present ballistic missile capability based on weapons of certain characteristics, or could they shift to entirely new delivery capabilities? Could they change the existing delivery capabilities so as to make them more resilient, more able to withstand attack?

So much of the work we do will be fundamental, will be basic in terms of understanding what can be done from a technological point of view, from an offensive point of view.

Another possibility for the countermeasures is to attack the defensive components, and here we have to understand, again, not only what the capabilities of the attack are, but also what we can do to protect the defensive components from that kind of attack. Can I have the next one, please.

[The chart follows:]



STRATEGIC DEFENSE REQUIREMENTS

- SURVIVABLE
  - DEFENSE SUPPRESSION MUST NOT BE APPEALING
  - DEFENSIVE SYSTEMS MUST BE "HARDER" THAN TARGETS
  - "COST" TO NEGATE DEFENSIVE COMPONENTS MUST BE GREATER THAN THE NUMBER/COST OF TARGETS THESE COMPONENTS CAN HANDLE
  - NO "ACHILLES HEELS" – I.E. BATTLE MANAGEMENT SYSTEMS
- ROBUST
  - SIMPLE GROWTH PATH FOR DEFENSES TO NEGATE "RESPONSIVE" OFFENSE
  - VISIBLE EXISTENCE OF ADVANCED DEFENSE POSSIBILITIES DETERS OFFENSIVE RESPONSES
- COST-EFFECTIVE
  - MUST "COST" LESS TO PROLIFERATE DEFENSE THAN TO PROLIFERATE OFFENSE
  - LEADS TO OFFENSIVE ARMS CONTROL POSSIBILITIES

Mr. YONAS. So these countermeasure driven technologies then allow us to define the components of the research program and allow us to define criteria that our research has to meet. And this is important in terms of understanding the types of problems that we work on.

To begin with, in order to have a point in the future where we can make a decision to a transition that did not cause adverse countermeasures, we would have to have a system which is survivable. I mentioned one of the potential countermeasures is to attack the defense. Survivability is necessary to maintain stability in a crisis so that the Soviets would not have any benefit, see any benefit from attacking the defense.

Chairman **LaFalce**. Dr. Yonas, I don't want to cut you short, but while I find this interesting and educational, I am most interested in your getting around to the use of offsets, to the contracting out to foreign governments or foreign firms, and its implications for the United States. So the sooner you can get to that, the sooner you get to the basic reason the subcommittee asked Lieutenant General Abrahamson to testify.

Mr. **Yonas**. I will do the best I can, sir.

I hope that by presenting some of the underlying features, I can give you the perspective in order to understand some of the requirements for the program, which then govern the nature of the research, which then govern how our allies will participate in the program.

These issues that I show here in terms of flexibility of technology, in terms of survivability, in terms of cost effectiveness, are the driving factors that will give the research character of the program. For instance, in the case of survivability, we may require a material which is lightweight, which is extremely strong, which has characteristics that can withstand a space environment under attack. The nature of that research will come to the foundations of fundamental materials science.

For instance, let's say in some—and we have talked to potential research partners in foreign countries.

Chairman **LaFalce**. Let me pick you up on that. This is the only way I am going to be able to do it. Having said what you said, why did you enter into an accord with Britain that arranged for participation in SDI research of British Government firms, and what is the purpose of keeping secret the details of that agreement?

Mr. **Yonas**. The purpose of entering into an agreement with the United Kingdom is to facilitate the broadest involvement, to facilitate the rapid progress, to exchange information and to provide the adequate security measures so that we can rapidly go ahead with solving some of these characteristic problems. For instance, let's say there is a particular idea——

Chairman **LaFalce**. Is it beyond the competence of U.S. firms to do this research?

Mr. **Yonas**. One of the things that we have been spending our time on for the last 6 months in visits to the United Kingdom, visits of their scientists and research here to the United States and visiting our laboratories, visiting our industry, is to determine where we have this complementary capability. Our interest is in providing——

Chairman **LaFalce**. It is nice we have complementary capability, but my question is, is the research that you contracted for with the

British beyond the competency or capability of the U.S. researchers?

Mr. **Yonas**. Yes, I understand your question.

Chairman **LaFalce**. I didn't understand your answer.

Mr. **Yonas**. If you will let me continue.

What we are finding out from these kinds of exchanges is that there are innovations, there are ideas that are different approaches which are not being pursued in this country, or there are existing facilities, prior commitments made for other reasons, for other applications whereby going to these capabilities we can get our job done better, faster, and cheaper in order to reach these very stringent goals.

Now, I think one of the things that one has to be aware of is that the United States does not have a monopoly on innovation and creativity and various kinds of technological capabilities. Our approach is to be able to provide to the American people answers to these difficult questions as soon as possible at the lowest possible price. To be able to find the most rigorous program which is why I explained our program earlier, to show you the rigor required in getting the answers.

We are finding in many countries capabilities which, we think, will allow us, to move more rapidly. The desire of these allied firms to get the rigorous answers to our questions is one of the motivations for going overseas.

Chairman **LaFalce**. I understand why one could be motivated to go overseas for the production of parts for cars, for windshield wipers or blades, and I can understand why one would go abroad for research. There are complex motives, good and bad.

And what I am trying to understand is how much research are we going to do in the United States, how much are we going to do abroad? What are the motives that are leading us to leave the borders of the United States? Because there is unquestionably some pretty good spinoff from military research, at least that has been the case historically. As a matter of fact, Lieutenant General Abrahamson recently set up an Office of Civil and Educational Applications within the SDI Program so we could obtain the commercial spinoff from the SDI research.

Now, it is going to be much more difficult to obtain commercial spinoff from technological research done abroad. It is also, it seems to me, going to be much more difficult to control the demonstration of that research information that we do not want disseminated if it is done abroad, as opposed to having been done in the United States, and it is also relevant whether the contract was with foreign governments or with foreign firms.

Before SDI goes too much further in contracting abroad, and I note that we did have this hearing scheduled prior to the contract with the British; at the request of the Defense Department, it was postponed, and then we had the contract with the British over the weekend. I want some explanations to the questions I have just posed.

Mr. **Yonas**. You have asked what is the motivation. Let me go through the motivation again.

First of all, this program is not oriented toward commercial spinoff. That is not the purpose of this program. The program is to provide the basis for a decision which affects national security in a profound way. It is not a commercial program.

Chairman LAFALCE. I understand that. The word "spinoff" takes care of that.

Mr. YONAS. We think it is necessary to be aware of the economic implications and, when possible, to facilitate that kind of benefit to the economy of the United States. But we believe that there are other motivations that one needs to be concerned about in terms of working with our allies.

The first one is this issue of internal security. We believe that it is necessary to have no independent levels of security between ourselves and our allies. For instance, in this case, we look to our allies and see they face a different——

Chairman LAFALCE. No independent levels of security between ourselves——

Mr. YONAS. No unequal levels of security. We believe there are threats which our allies face, in particular short-range missile threats, which are different than the kinds of threats we face, and the program we are pursuing is involving the defense against long-range, as well as short-range, missiles.

When we look to the capabilities, we see overseas in terms of the investments they have already made in laboratories and researchers and fundamental work and actual implementation, in sensors, interceptors, battle management hardware, battle management software, we believe they have special capabilities because of their prior investments to move rapidly, to assist us in evaluating these technologies for defense against short-range missiles. We think those are unique capabilities they have because of their prior investments.

Chairman LAFALCE. Can you categorically say no one in the administration has given consideration of contracting out in order to obtain support of the SDI Program?

Mr. YONAS. I can say categorically that the purpose of dealing with our allies is to provide a way to solve these problems better, faster and cheaper than if we did not look outside our border.

Chairman LAFALCE. A nondenial denial.

Mr. VENTO. Will the chairman yield?

Chairman LAFALCE. Yes.

Mr. VENTO. Just in quoting from General Abrahamson, he goes through these on page 14, I call to the attention of the committee members, and he said "Involvement will certainly lead to a more in-depth understanding of the program,"—he is speaking of our allies—"and the technical basis for defense as well as its military basis. This understanding will be a vital underpinning of a future decision to proceed into development."

I think that he is saying that we want to have an understanding by our allies of what we are doing. Whether or not the means by which we pursue the development of any given weapons system, whether it is a fighter carrier or this particular program, relates to whether or not they have an unequal or equal role—is it a question here of maybe the Defense Department, SDI Office and others have grown too big for their britches?

In other words, the question the chairman asked you and you didn't answer, Mr. Yonas, is can you say we do not have the capability to do the R&D work in this country?

Mr. **Yonas**. In many cases, there are technologies we are finding overseas that will allow us to do this job cheaper, faster and better, and I would suspect, Mr. Congressman, you would ask us in the Pentagon to apply the kind of competition that is required to stimulate achieving our goals in just as low cost a manner as possible. That is required of us, and we think that by going overseas we will be able to do this job in a way that will provide the best product for the American public.

Chairman **LaFalce**. Did we go abroad in our research in the Apollo Space Program, the Manhattan project, et cetera?

Mr. **Vento**. Where have we done this before?

Mr. **Yonas**. I can mention something about the Manhattan project I think is particularly interesting. The key figures in the Manhattan project, I am sure you are familiar with Teller, Beyda, Chistiakowski, Van Noyman and Leo Sellart, all right down through the list. The key contributions to the Manhattan project, time and time again, were made by people not born in America. What we found out at that time is there were capabilities outside these borders, that these capabilities allowed us to achieve our goals because there was a framework in which these people saw a threat, a threat from outside our borders and sought to solve these problems.

Now today we are looking at a different kind of a problem which we all face, the whole world faces this problem, and we are looking to a solution to change the basis of deterrence. Isn't it ethical and logical to ask our allies to participate in this kind of venture?

Chairman **LaFalce**. Are they contributing in the funding of it?

Mr. **Yonas**. Right now we are not asking for direct cash, but let me say this. To the extent to which our allies have already made investments, for instance, in facilities, innovative concept, for instance, in the United Kingdom we see investments that already exist which they are bringing to bear, which they are bringing to the table in terms of these cooperative programs, that is a real investment. It is their brain power, their facilities and their prior ideas that they are bringing to the program, and what we are trying to do is to capitalize on that investment to move forward more rapidly together to solve a common problem.

Chairman **LaFalce**. Do we have a rough idea of how much of our SDI will be spent here in the United States on research and how much abroad on research?

Mr. **Yonas**. We have no notion of that kind of split or any kind of offset or guarantee for any of the people we are talking to. This is being handled on a case-by-case basis in terms of being able to show that the people we are talking to can compete, can compete fairly, so we can get the job done.

Mr. **Vento**. Mr. Chairman, Mr. Yonas presents this as simply a question of competition. Of course, we all know we have been accused of the brain drain in terms of bringing the finest minds to bear on the Manhattan project, the space initiative and so on, work done within this Nation, developing human resources, the educational facilities, the research capability of our education institutions as well as our corporations. The fact is that this is substantially different. I have not heard him say there is a track record for the development of anything of this particular nature in the past. The fact of the matter is the memorandum of understanding that has been signed with the British, whatever else it may be, certainly is not a model where we are going to have competition. In fact, it is a reservation of a certain amount of work, a certain guarantee and assurance to the United Kingdom of a certain amount of work that is going to be done there.

In other words, you have chipped off a piece of something and put it in there and agreed to give it to them. Plus, insignificant as they may be according to Mr. Yonas, the commercial applications are there, if we can believe what we read in the paper, but I think that we would obviously like to see this document and other subsequent documents.

So I want Mr. Yonas to respond to that. He says it is a model of competition. Is it a model of competition? We sit down and carve out a piece and say this is for the United Kingdom because you have certain technical capabilities. Is that competition? What bids were put out to the other companies with regard to it?

Mr. **Yonas**. With regard to the notion of a set-aside or carving out a piece or defining some practicalities of the program, that has not been done. What we have attempted to do is provide a understanding to facilitate that kind of competition, to give the knowledge about what are the opportunities so that the United Kingdom firms or laboratories can compete fairly in order to provide, where they have the knowledge, where they have the facilities, to allow them to provide an opportunity to——

Mr. **Vento**. Are you saying there will be no sole source contracting, single source contracting to a British firm?

Mr. **Yonas**. I am sure you are aware if there is a sole source it has to be justified in terms of the characterization—in terms of laws and regulations that exist today.

Mr. **Vento**. I understand that. That is not exactly competition in the same sense we may look at bidding for an American firm to do that. Do American firms have an ability to do this work or don't they?

Mr. **Yonas**. There is no question about the fact when an American firm has the ability to provide these kinds of services there will be every opportunity for an American firm to provide those opportunities, even though a contract has——

Chairman **LaFalce**. Even though a contract has been entered into with another country?

Mr. **Yonas**. There has not been a contract with another country. What we have created is a memorandum of understanding to facilitate this process in order to have the most rapid and broadest involvement in the various areas of the program.

Chairman **LaFalce**. Why is it necessary to have this agreement secret or am I incorrect?

Mr. **Yonas**. The memorandum of understanding is secret and will be provided to the Foreign Relations Committee.

Chairman **LaFalce**. Provide it to who? The——

Mr. **Yonas**. The Foreign Relations Committee.

Mr. **Vento**. By law. It will be provided by law to the Foreign Relations Committee. How soon will it be provided? Has it been provided? You appeared at least—someone from the office was before the subcommittee this morning. Has it been provided?

Mr. **Yonas**. It will go through the normal procedures of the State Department. I am not aware of the schedule. It will be provided according to law. The terms and conditions of that agreement have been outlined, and I want to emphasize this fact, not to break off or set aside any portion of the program but to facilitate in an efficient manner for satisfying important needs. For instance, the issues of national security require that the information in a classified realm has to be protected in certain ways, and so we have to establish the procedures to facilitate that kind of protection. That is an example of the kinds of conditions in that agreement.

Mr. **Vento**. I understand that is very important. I am sure all of us would agree with that, especially when you start talking with the German Federal Republic or Israel in terms of participation based on what has been going on in the last months. The fact is, of course, that, Mr. Yonas, we have the movement across this country of people, foreign delegations coming to contractors here to try to gain an understanding of how this works. It has made it all but impossible to even work in some of these facilities. If you can picture the problem of the various contractors with delegations marching in and out, investigating what possible contracts of which they might be able to take advantage. All this while trying to retain security. We now have got these contractors, these various groups coming in, walking through the plants with a shopping cart selecting maybe one of these, one of those, maybe I can negotiate with Abrahamson on this particular issue.

What does that do for national security when you have that sort of spectacle going on?

Mr. **Yonas**. Whenever we have any kind of interaction with a foreign government the participants have been cleared. If we are going to talk classified information, the exact nature of that information is specified beforehand. If it is an unclassified business, that is specified beforehand, and we provide a well-established procedure for protecting national security interests in any of these exchanges.

Mr. **Vento**. Well, I understand that, but I think that you have compounded the problem greatly by not following maybe the model of the Ugly American in terms of brain drain and so forth by not saying to a corporation, here is a project, we are going to do it, here is your piece of it, get the resources where you can instead of trying to look around. As an example, we send out 18 invitations for NATO and various allies to participate. Mr. Yonas, maybe you can enlighten me, what capability specifically were you seeking from Turkey with regard to help with the Strategic Defense Initiative Program?

Mr. **Yonas**. I think in every one of these cases we were not seeking a specific kind of opportunity or stance from any one of these countries. What we are telling them is if they have particular capabilities, if they have particular opportunities, they felt they could make a contribution, they were free to do that. We would like to understand what they had to offer. We could listen to them and provide a way to evaluate those capabilities.

Mr. VENTO. Has Turkey made a visit to this country? Many other nations have. I am interested in whether or not they have responded.

Mr. YONAS. I am not familiar with that.

Mr. VENTO. Has Turkey responded?

Mr. YONAS. As far as I know there has been no visit from Turkey.

Chairman LAFALCE. In your memorandum of understanding with the British, is there any dollar amount that is dealt with?

Mr. YONAS. In that understanding we have not attempted to make any prior agreement on the dollar level of that program.

Chairman LAFALCE. Is there any dollar amount mentioned as an intended goal at all?

Mr. YONAS. We have not made any goal or any acknowledgement of any dollar value. What we have tried to do is facilitate a scope of work by defining the various technical areas where we think the United Kingdom can make contributions to the program to give them an opportunity to exchange with us information in those areas where we think they can make that contribution and to show to them our intention to give them that full opportunity across the board.

Chairman LAFALCE. So it is my understanding then that the agreement you might have with other governments would probably differ, because the nature of the research that may be done in other governments or in other countries might well differ from the nature of the research that could be done——

Mr. YONAS. Yes. It is a strong function of their capabilities. In fact, part of this procedure we have been going through which has been admittedly time consuming for us, has required exchanging of information on both sides. They have capabilities, we have to understand what those capabilities are. They have to understand what the problems are.

Without our telling them anything about the solution, they have to know what the problems are. This information to a large extent is publicly available, but it is the face-to-face discussion with engineers and scientists that is necessary to have an understanding what you need—what are the problems and what solutions can you bring to bear to the problem?

Mr. VENTO. Mr. Chairman, I think that simply compounds the security issue that has been raised. And the fact is that the agreement with the British Government means that instead of dealing on a contractor-to-subcontractor basis or company-to-company basis now all of these agreements necessarily have to go through the British bureaucracies, don't they?

They are saying they are getting an overall handle on this issue. And in that agreement are there assurances of spinoff of commercial technology to the British—your British counterparts?

Mr. YONAS. First of all, we haven't precluded any company to company contractual relationship——

Mr. VENTO. Will it have to be monitored by the British Government?

Mr. YONAS. In cases where there is national security information exchanged, yes, in all cases those exchanges of information and the security regulations are handled on a government-to-government basis.

Mr. VENTO. In other words, this knowledge that is acquired will become common national security knowledge of both the United Kingdom and the United States; is that correct?

Mr. YONAS. There are well established laws and regulations for protecting national security information. All of these agreements will be following these time honored procedures.

Mr. VENTO. I understand that but, of course, you are multiplying the amount of this under this, if in fact, there is any progress or any information that is acquired. Aren't you?

Mr. YONAS. We would hope there would be substantial progress. We think this kind of exchange will allow us to move more rapidly and achieve our goals at a lower cost to both sides.

Chairman LAFALCE. Dr. Yonas, much of the previous projects, such as Apollo and the space shuttle, didn't have quite the classification as SDI, is that basically correct?

Mr. YONAS. The Manhattan project certainly was highly protected.

Chairman LAFALCE. Manhattan certainly was, and of course, all those physicists you mentioned as I recall who did the research on Manhattan and within the United States; isn't that correct?

Mr. YONAS. Yes, that is correct.

Chairman LAFALCE. Even though they might have been citizens of a foreign country they were here within the United States in our laboratories, correct?

Mr. YONAS. Yes.

Chairman LAFALCE. All right. Fine. Insofar as the other programs I mentioned, they did not have the classification of an SDI Program.

Mr. YONAS. I think there is some precedence here I would point out. In regard to our existing agreement in nuclear weapons development with the United Kingdom, the 1958 agreement. During that time period we established mechanisms for exchange of information and protection of information, and that joint working agreement has been applied over this entire time period with great benefit to both countries in the area of nuclear weapons.

Chairman LAFALCE. All right. Let's get to a basic point this subcommittee is interested in, and that is the commercialization, the spinoff if you will. We understand the program does not have that as its primary intent but we also understand that it will be an effect, and that, of course, is the reason General Abrahamson set up an office of civil and educational applications.

Now, I am wondering what your thoughts are for balancing the military prerogative and the potentially widespread probability of commercial products in the United States that could come about because of the hope for commercial spinoff?

I am wondering how you are going to achieve that balance in the United States. I am even more concerned about how you intend to control the commercialization of technology in Europe, especially where contracts have been made with individual foreign firms rather than with foreign governments.

Mr. YONAS. To begin with I can't emphasize too strongly the purpose of the program. It is a national security program and not a commercial program. To the extent there are commercial areas that spinoff can come from the work.

Chairman LAFALCE. You keep saying that. Let me ask you this: What was the purpose of General Abrahamson setting up an office of civil and educational applications?

Mr. YONAS. There will be information that will be made available as a result of the program. In many cases, the problem of, "technical transfer."

Chairman LAFALCE. Wasn't this a purpose of the office of SDI, to have civil and educational applications?

Mr. YONAS. To be able to facilitate the information that can't be really disseminated to make sure the information is available so it can have the widest use and benefit.

Chairman LAFALCE. So it is a secondary purpose.

Mr. YONAS. There is no question about the fact—we do not wish in the Pentagon to bottle up this information that can have widespread benefits. Earlier in my talk I mentioned that the program really has a research character.

Much of this work is rather fundamental. When you work on basic work, work that is fundamental to, for instance, material science, in the process of carrying out that work you really don't define the application, you are at a point in a flow of information where you can either go to a specific military application or you can go to a civilian application.

Along that process, in that part of the work, there is an opportunity to apply that work for a commercial impact. That is just the kind of work you don't want to bottle up, you want to make sure those reports are ready, that conferences are available, and that information goes out when people call up. The public should know who to go to, and how to get hold of information.

That is the kind of flow of technology to the private sector we think will have economic benefit, and it is something we think we ought to—where we can—facilitate.

Chairman LAFALCE. Good. Well, I couldn't agree with you more, and I am excited about that prospect of the SDI Program, having qualms about other aspects of it. But, of course, if you are going to do considerable amounts of research abroad, it would abort the effort to have commercial spinoff within the United States. And might facilitate the ability of foreign governments to have commercial spinoff abroad for which their economic sector could take advantage. How do you intend to deal with that issue?

Mr. YONAS. Let me tell you something about my personal view of how technology starts from this stream of basic knowledge and goes out and gets applied. To a large extent it is limited by the creativity of the people doing the work and by the infrastructure of the capital formation to apply that work to various applications.

Because of the broad range of the economic opportunities in this country, because of the ability to form capital to flexibly set up companies, we really have an ability to move out rapidly. We are a model for the rest of the world in being able to apply these technologies. When I talk to Europeans about the SDI they are concerned about the opposite of your concerns, they are worried about the technology gap, the possibility we will be making quantum jumps in technology and leaving them behind.

When I talk to them about that concern, my response to them is to say, look, if you have people who have creativity, if you have people in your capital sector who are willing to take a risk and take a venture and try to apply some of these technologies you can do it too. But it is really going to be dependent on our willingness to take ideas across the board whether they come out of the commercial sector or military sector, apply them and move them forward to some kind of application.

But I think this country has an advantage. We apply these technologies every day, we don't let them lie dormant. I think we can benefit greatly across the board from the fundamental technology. What we are doing in the SDI, although that is not our emphasis, is making sure those opportunities are available from the basic work if people choose to apply them, take the risk and go and produce some kind of a product or useful benefit to the country.

Mr. VENTO. Mr. Chairman, just as long as we are talking about each other's philosophy, I thought I would tell you a little bit about mine as I look around the landscape in Minnesota.

As people start their projects, like Bill Norris and others, they are scientists working in this field and they had the idea. Their companies have taken that idea and moved off with them. We, by some millions of dollars, invest in our British or other European allies and so forth, they are going to be the ones that are going to have the wherewithal to do this.

I think that is wonderful that they do it. I just think that I question whether or not this is the best way for us to accomplish the purpose in terms of what we are doing just in terms of the educational expertise and so forth that gets developed here based on this.

We can all argue about whether or not we are going to build a certain system or invest heavily in R&D, but I have figures here that indicate this as it moves along the SDI will, in fact, be about 30 percent of our R&D; 30 percent of our R&D dollars will be going into SDI, 30 percent. So if we take a significant portion of that, whether it is 10 percent of that 30 percent or 20 percent of that, and it is absorbed by these foreign activities in terms of these memorandums of understanding, that substantially reduces the amount.

We know since we are putting the funds there we are not putting them into other avenues which have direct commercial application. We know there is a secondary goal, but the whole infrastructure in terms of schools, corporations and so forth, I think depends upon those dollars which we have and invest.

We have just so many dollars we are going to spend on these particular programs and so I think that is the concern that we have as a subcommittee. As an example, since we are in Congress proposing less than has been requested by the administration, in essence stretching out at least for the moment the SDI and R&D moneys, doesn't that have any impact, doesn't that mean we are even less in need of the allied participation in this program, Mr. Yonas?

Mr. YONAS. Well, the budget cuts we think are unfortunate and have caused us to make in some cases what we consider to be premature decisions in terms of certain technologies which we will have to hold back. In many cases we see that there are technologies across-the-board that are advancing rapidly and give us opportunities to exploit those capabilities.

In cases where we can exploit the capabilities at a lower cost within this constrained budget and get to those results sooner by finding a partnership with one of our allies, for instance, in a case where a certain country has made a prior investment because of another problem, a problem that it sees in its own national security, by an opportunity to move forward with its investment that it brings to the table in terms of people, facilities and ideas, to allow us to do our job within this constraint budget sooner and better, we would like to be able to take that opportunity so we can get the job done in spite of these budget cuts.

Mr. VENTO. I understand, but it still is a slower spendout, is it not, in terms of R&D? You think you might be able to get more done for less. I am happy to hear that.

Premature decisions, I don't know. I guess that is life, you know, but allied participation is being affected by that or should be affected in terms of what we are doing. Let me ask just to get on the record, is any of the reaction of some U.S. scientists to reject some of the Star Wars work or the SDI work any factor in terms of the allied participation?

Mr. YONAS. No. There are vocal people who have been opposed to this work and have refused to participate, but our approach to providing, as I mentioned, a solution to these critical issues is to move forward rapidly with the industry, with the universities, with the small laboratories who have shown an active desire and great deal of innovation for moving forward rapidly.

We have many proposals across-the-board, for instance, from universities, to pursue these areas and it is unfortunate we cannot support all of them to the extent that they would like. I think there is a great deal of capability both in this country and, as we are finding out, a great deal of capability overseas.

Mr. VENTO. That leads into my next question. Are the U.S. contractors or research facilities choking on so much research that they simply can't absorb the types of contracts that you are putting out? In other words, we must go to the European or other allies for this particular work?

Mr. YONAS. We see the opportunity to go to the allies as a way to enhance the program.

Mr. VENTO. Do we have the capacity here?

Mr. YONAS. We are seeing, based on various reviews of the manpower availability, that the SDI is taxing only a very small percentage of the capabilities except in certain fields, for instance, optics. In this country we have an inadequate supply of optical scientists for the kinds of programs we are pursuing, particularly in directed energy.

Here is an area, for instance, in certain countries, such as Germany, where they have a great capability in optics, we find we can, by working together, we may be able to reach our goal sooner.

Mr. VENTO. Wouldn't this be an opportunity to enhance our capabilities by placing the contract here and developing that?

Mr. YONAS. There is no question about the fact we will be making additional emphasis in the optics area in that kind of research, but we also see the ability to move forward more rapidly by working in this case with the Germans in the optics area.

Mr. VENTO. Will you answer the question about the commercialization? Is there any assurance in the memorandum of understanding that you can share with us with regard to commercialization in the United Kingdom?

Mr. YONAS. The goal of this work is to provide mutual, full benefits to both sides.

Mr. VENTO. Is it addressed in the memorandum of understanding, the commercialization issue?

Mr. YONAS. I don't think the word "commercialization," but I think in terms of exploitation.

Mr. VENTO. In substance.

Mr. YONAS. Basically we are talking about the rights to exploit the work and those rights are included in the program.

Mr. VENTO. That will suffice.

My name isn't Hayakawa.

Mr. YONAS. Yes, but the word "commercialization"—it raises property rights. The rights to exploit this work may, in fact, accrue to military application, which would then have certain security implications on both sides and the rules and regulation which apply.

Mr. VENTO. Or to nonmilitary in the case of nonclassified information.

Mr. YONAS. Yes.

Mr. TORRES. I wanted to follow up a little further on Mr. Vento's questioning. I know that given the budgetary constraints we are dealing with in Congress now, we see a decline obviously in the kinds of financial inputs to our higher education efforts here in this country.

Clearly SDI is going to be a windfall for academic. I think that universities are going to reap a windfall, as I said, in new equipment and new facilities and staff, and some universities, of course, will want to take advantage of that. So be it. I think there are some here in this country that are well qualified for that.

In your discussions you talk about military and commercial innovation from abroad and you touched a little bit on some university input from abroad. To what degree is this contracting with our allies, with the Europeans, taking into account or setting aside agreements with university forces in those countries?

I am asking the question obviously at the expense of our own American universities.

Mr. YONAS. In the case of basic research, fundamental work, which relies on creativity, innovation, we believe much of this kind of contribution can be made by our own academic community and so within our program we have provided a mechanism for dealing with in many cases high risk, long-term research, but that is still very fundamental.

We provided special funds in our program for this kind of work and we are seeing thousands of proposals from American universities and we are beginning to see proposals from foreign universities to do this fundamental kind of work.

Now, this kind of fundamental cross fertilization, both within our country and outside of it, is the kind of creativity that leads to advances that spill over into technology. This kind of technology has never been restrained in any way.

That kind of fundamental work benefits all of the science and technology research being done around the world. When a program moves forward rapidly, it is not that somehow one country has the proprietary rights over that kind of fundamental knowledge. The nature of the work is that knowledge and capability are available to all. To the extent to which you can benefit from that knowledge is really a function of your infrastructure, your ability to raise capital, your technical ability, and your willingness to take risk.

I think this country has great capability to take advantage of those kinds of ideas.

Mr. TORRES. Already the approach you have been taking is open to the suspicion—this procedure is kind of a stick and carrot approach to our allies in order to bring them into our confines, so to speak.

Don't you think this sort of approach is going to expand the argument from other countries around the world from our own critics here in this country that this is a political device to bring our allies into conformance with our own SDI approach?

Mr. YONAS. As I said earlier and, I want to emphasis this, it is important for us to establish an understanding among our allies about the inherent nature of the technical work. It is very difficult for us to understand the details of complex issues without some involvement. It really wouldn't make sense for us to go through a long-term research program at the end of 5 years to try to communicate the good points and the deficits in some parts of the research that a direct involvement across-the-board throughout the nature of the work I think is the best way to have that total understanding.

So from that point of view there is a political dimension. There is an understanding or a policy element of this kind of joint work so that we understand fully the nature of the technical capabilities. But the other issues, I think, are the dominant issues, the desire to do this work as rapidly as possible and the fact there are technological capabilities out there that we highly value and which will have great benefit to the program.

Mr. TORRES. Thank you, Mr. Chairman.

I yield back the balance of my time.

Chairman LAFALCE. Dr. Yonas, on the one hand I was concerned about giving too much research moneys to foreign governments or foreign firms. On the other hand, it is my belief based on knowledge and belief that the primary motivating force in reaching out to foreign governments is political.

We hope to garner their support for the SDI Program and only incidentally do we rationalize that attempt to reach out to foreign governments and companies on the basis of their technical capabilities.

Aren't we going to undermine even that political purpose though when they get an awful lot less than they expect? For example, didn't the British request a commitment of about $1.5 billion? I am not saying you gave that, but didn't they request a commitment of about $1.5 billion?

Mr. **Yonas**. As far as I know, the British had certain preconceived notions of the extent to which they could participate in the program and we listened to their idea of what they could do in the program. We were unwilling to give them any kind of guarantee or set-aside, but we did encourage them to consider an opportunity to participate in the broad range of the research area.

Chairman **LaFalce**. I understand that. We denied them $1.5 billion. We promised them "substantial" and we gave them a wink with the word "substantial" that could lead them to believe they might get $1.5 billion, when in reality European companies might get about $30 million in the near future, and maybe $300 million over a 5-year period, at least according to the estimate that is going to be made by the next witness, Mr. Pike, of the Federation of American Scientists.

Mr. **Yonas**. I can't substantiate his estimate.

Chairman **LaFalce**. My point is we might be building ourselves up for a fall. In other words, in an attempt to build up political support—assuming we do want to proceed on the strategic defense initiative—that it is creating false hopes and is going to undermine whatever support might be created on a short-term basis.

Mr. **Yonas**. For this very reason we have made sure in all our discussions, have emphasized the fact we are interested in product, we are interested in time, we are interested in cost, we are interested in performance.

Those kinds of issues will be paramount and dominate our decisions in terms of work we will do and not do. I think they understand that they should not have false hopes.

Mr. **Vento**. Mr. Chairman, in the Washington Post report, it says through Government agreements, "a 12-page memorandum of understanding, outlining a framework for British scientists and industry to take part in the controversial, multibillion-dollar program," this will be the framework around which other contracts will take place; is that correct, Mr. Yonas?

Mr. **Yonas**. There will also be an opportunity to go on a firm-to-firm basis as through the overall agreement.

Mr. **Vento**. The concern here is, of course, they said the agreement outlines at least 18 areas. What are those 18 areas? Could you submit that for the record, Mr. Yonas?

Mr. **Yonas**. Yes.

Mr. **Vento**. It says laser computer and optic research, for the benefit of my colleagues, but I mean I expect it goes into specifics and that it will quickly bring substantial awards.

We are dealing in generalities and I think that having the memorandum of understanding or at least having the opportunity to look at it would assist the subcommittee. What assurances are there that we won't end up double funding both a SDI Program and, for instance, a Eureka Program in Western Europe?

Mr. **Yonas**. We are not that familiar with the nature of the Eureka Program. We certainly do not see it as a committed program or military program.

Mr. **Vento**. I understand that is what it is, but what assurances if, for instance, we are dealing with the German Federal Republic and private contractors in France, because of the Government's rejection of SDI there, that there will not be a technology transfer even under the agreement? In other words, it is our objective, you said, to share with them that information to permit them to go forward. Couldn't they plug that information back into the Eureka Program.

Wouldn't that be possible?

Mr. YONAS. I am not sure of the content of the Eureka Program or the direction that will follow. It is a hypothetical area. I am afraid I just don't have the information on it.

Mr. VENTO. Let me ask about a less hypothetical situation. Within the context of the ABM treaty there are references in article 9 and in the agreements, statement G, that fundamentally say that we are under limitations, treaty limitations with regard to sharing various technologies or components or blueprints, I guess, they use the word and I am mixing these intentionally because I want you to respond to that.

Obviously, the bell has gone. Can you respond to that?

Mr. YONAS. The ABM treaty provides no limitations on research and provides no limitations in the ABM area, but it does prohibit the transfer of blueprints and prototypes. We have no interest in that.

Our program is nowhere near that stage of evolution. Our program——

Mr. VENTO. In other words, what you are saying is that we are going to go down the path in terms of developing this research with our allies and that at some point some magical line then we won't be able to step across that because of this treaty, is that it?

Mr. YONAS. The treaty has a barrier to transfer of information in terms of blueprints and prototypes and that barrier would have to be followed.

Mr. VENTO. Isn't this exactly the concern the Europeans have expressed in past research work we have done where we have not shared and they have received none of the benefits because of this sort of limitation?

Mr. YONAS. We are not forcing our allies to participate in the program. We have asked them if they would like to participate, to make their proposals known to us in full understanding that we will be totally compliant with the rules and regulation of the ABM treaty which does not prohibit——

Mr. VENTO. Isn't this a misrepresentation then to them to some extent?

Chairman LAFALCE. That is the last question. Please respond.

Mr. VENTO. Isn't this a misrepresentation to them then?

Mr. YONAS. I am afraid I don't understand the question.

Mr. VENTO. That they, in fact, will not be fully sharing because of this limitation, this treaty limitation?

Mr. YONAS. No; there is a full understanding that the program will be carried out in compliance with the ABM treaty and they understand that.

Chairman LAFALCE. The subcommittee has 5 minutes in which to cast their votes on final passage of the Farm Credit System bill. Subcommittee will recess for 10 minutes. Before we recess, however, do the other members of the committee have any further questions of Dr. Yonas?

Do they want him to return?

Mr. VENTO. I understand that he had other commitments so I think we will have some questions in writing and we will honor his time commitments.

Chairman LAFALCE. He is excused.

We will submit written questions. When we return, I know Ms. Marlin has to catch an early plane to New York City so we will hear her testimony as expeditiously as possible.

Thank you.

[Recess.]

Mr. VENTO [presiding]. The Subcommittee on Economic Stabilization will resume its sitting. The chairman had a conflict and has asked me to start the hearing immediately to accommodate the schedules of the other two witnesses. We have Mr. John Pike, associate director for space policy, Federation of American Scientists, and Ms. Alice Tepper Marlin, executive director of the Council on Economic Priorities.

Both of your statements have been received. Without objection those statements will be made part of the record, and you may proceed to summarize.

I understand that there is a conflict, that is to say, your schedules—who has a schedule problem?

Ms. MARLIN. I do. I think I have resolved it. Thank you very much for expediting things.

Mr. VENTO. Thank you. I am sorry we didn't proceed more expeditiously but I think you can recognize the keen interest of the chairman and the other members concerning the recent witness. Why don't you proceed to summarize your statement and we will move to Mr. Pike.

STATEMENT OF ALICE TEPPER MARLIN, EXECUTIVE DIRECTOR, COUNCIL ON ECONOMIC PRIORITIES

Ms. MARLIN. That was a wonderful questioning session, Mr. Chairman. I was very happy to be made late by your excellent questions, and I am deeply grateful to you for allowing me to testify before you today. If implementing President Reagan's vision of a space based defense of population could make nuclear war obsolete, it would be worth virtually any price.

But even before establishing feasibility and strategic impact, the Congress is being asked to allocate sums which are quite literally astronomical. The R&D stage alone is the largest military venture ever proposed. Since planners have not even defined SDI's architecture estimates of costs necessarily range widely.

Official estimates of full costs go from roughly $100 billion to $500 billion. By the Council on Economic Priorities' estimates, based on historical ratios to research and developments costs, deployment of a strategic defense could run anywhere from $400 to $800 billion.

We can of course get a far narrower range of estimates for the R&D stage, to determine what might be feasible. The Defense Department has already spent $2.3 billion in the last 2 years and will spend an additional $31 billion during the next 6. That exceeds the research and production costs combined for major programs such as the MX missile and the B-1 bomber. And independent estimates range much higher.

While the United States with a gross national product of $4 trillion could finance programs of even this size, the strain would not be insignificant. Thirty-three billion dollars is certainly what Senator Dirksen would have called "real money." Cutting it could make a sizable dent in the Federal deficit. Keeping it without tax increases is likely to occur only at the expense of further cuts in civilian programs. The rate of expenditure escalation, as you can see from the chart over there, is quite steep. SDI appropriations will increase 35.8 percent in constant dollars in fiscal year 1985.

During fiscal year 1986 as you can see on the R&D's of that chart, budget authority is slated to expand by almost 90 percent in real terms. While strategic defense research will require only a small portion of total national R&D, growth is so rapid that it may well crowd out other research and development efforts with less political clout.

Between 1984 and 1990, SDI is slated to grow from 3.7 to 13.1 percent of the DOD's total RDT&E budget. SDI will consume 31.8 percent of the projected increase in national research and development spending in 1987.

Moreover, an expense of this magnitude involves substantial opportunity costs. Our strategic defense initiative undertaking could disadvantage the United States in international competition by diverting scarce resources and prized technical talent into arcane avenues of research which lack commercial potential.

The deep recession that began in 1981 ameliorated the tight job markets in computer science and engineering. However, high economic growth coupled with high defense spending over the next few years could again tighten labor markets for scientists and engineers according to the National Science Foundation. Though it is unlikely that jobs will go unfilled, the increased demand could draw away appropriately trained and experienced personnel from other fields. There is some indication that on the basis of salary alone, defense contractors are able to attract the best personnel, a palpable drain on commercial enterprise. In a survey of its membership in 1983, the Institute of Electrical and Electronic Engineers found the median salary of engineers working in aerospace and defense was significantly higher than the median engineering salary—$45,095 versus $40,000. On the other hand, salaries of new graduates going into aerospace are not substantially different than other fields. It is conceivable that up to 10 percent of the job openings for computer specialists and aeronautical/astronautical engineers may have to be filled by personnel transfers from other fields as near as 1987.

For industries requiring these specialties, these high transfer rates could impose substantial costs, including more training, recruiting and payroll expenses, yet create very few blue collar jobs.

For the Nation's defense contractors, however, the timing of SDI couldn't have been better. As production contracts for big ticket items like the B-1 bomber and the MX missile wind down, SDI can secure these firms' financial positions for decades to come.

In fact, the benefits of SDI will accrue overwhelmingly to the same regions and contractors that now depend on military spending.

Over 90 percent of strategic defense and antisatellite weapons contracts in 1983 and 1984 went to just four States—California, 45 percent; Washington, 22 percent; Texas, 13 percent; and Alabama, 10 percent. And despite assertions by SDI officials that small innovative firms will get their fair share of SDI, the top 10 contractors got 87 percent of all awards through October of 1984.

European governments, including those which have been the most supportive of the Reagan administration's military policies, have questioned SDI's effects on Europe's national security needs. Yet, in Europe as in the United States, electronics, aerospace, and other technologically oriented firms have moved rapidly to seek a piece of the star wars action.

Among European nations, only Britain and France possess an independent nuclear deterrent and neither can come close to matching the Soviet arsenal in either quantity or quality. Ever since accepting the protection of the American nuclear umbrella, our NATO allies have been concerned about how the United States would respond in the event of a crisis largely confined to Western Europe.

Would the United States use its nuclear arsenal to protect Europe and open itself to Soviet retaliation, or would we hold back our weapons to deter the Soviet Union from escalating our European-based conflict? The possibility that the United States would decouple itself from Europe was one of the issues in the European debate on the deployment of Pershing II and ground-launched cruise missiles.

Europeans are also concerned about tying their national security policies to the ups and downs of U.S. defense planning. European memories are long and European leaders still speak of Prime Minister Harold MacMillan's chagrin at having President Kennedy and Defense Secretary McNamara cancel the Skybolt Missile Program. What if a future administration should cancel SDI? What if Congress should give the go-ahead now but later cut back the system in its quest for budgetary balance. Many Europeans point out that SDI, even if it were to be effective against long-range ICBM's and SLBM's, would not be very useful against short-range or low-trajectory missiles or nuclear capable aircraft weapons likely to be used against European targets in the event of war. Because of these concerns some European leaders have proposed that Europe have nothing to do with SDI, and instead develop its own program of research on space technology.

This could take the form of a civilian effort as in the Eureka program proposed by France and now gaining support throughout Europe or possibly even a military program investigating a purely European space-based defense system. When Secretary Weinberger invited European companies to compete for SDI contracts, however, a number of Europe's prominent defense and electronics firms have expressed interest, and in some cases have opened discussions with the SDI program office. Fiat of Italy, Matra of France, Plessey and British aerospace from the United Kingdom and Messerschmitt Boelkow-Blohm and Dornier of West Germany are only a few of the European countries seeking SDI work and the list could be readily expanded to include dozens, if not hundreds, of companies, non-profit and university-based research institutes, and individual consultants. One reason is fear of being left behind in the technological dust of Japan and the United States.

But it appears the predominant reason European contractors would jump at the chance to do business with the Pentagon can be captured in Willie Sutton's famous aphorism: "That is where the money is." Or as a British participant put it at the Wehrkunde meeting of defense specialists in Munich earlier this year, "Our snouts are already twitching to get to the trough."

I am aware of no offsets to the United States for our SDI purchases abroad. In contrast to the stratospheric budgets for our SDI, Eureka is currently viewed as a $5 billion project, and Europe would have to pay its own bills. Using U.S largesse has other potential advantage for contractors.

European companies along with the trend over the past 5 years, are hoping to forge long-term relationships with American firms through joint ventures and subcontracting to gain access to the entire U.S. defense market in the 1990's.

These motives are sufficient to explain why business in the United States and Europe jumps at the invitation to participate in SDI. More questionable rationales have been marshalled in support of the program, namely that SDI will result in valuable spinoffs that will benefit civilian technology and increase productivity.

General Abrahamson lists specific product areas to be benefited by SDI spinoffs and has stated that such spinoffs can help SDI pay for itself. Yet predicting the extent and kind of eventual SDI spinoffs is a far more difficult task than information forecasting its full cost which the SDI claims to be unable to do.

Defense officials continually state that the ultimate architecture of SDI will only emerge from the research and development process and cannot be predicted at present. Officials also are not capable of knowing what products and processes will be in demand in the 1990's, and whether the potential spinoffs from SDI will be sufficiently reliable and cost competitive for civilian markets. I must warn you, however, that SDI's performance requirements are so extreme that its technologies appear unlikely to find cost-effective uses in commercial products. If the past is any guide, there will be spinoffs from SDI, as there have been from the space program and from previous large weapons procurement and research programs. But the past also suggests that the number of concrete examples will be few and the dollar benefits will be small in relation to the costs.

Most industry level economic analysis do not find that government sponsored R&D improves economic efficiency. R&D sponsored by the firm themselves, on the other hand, tends to be strongly correlated with increased productivity. One study suggests that firms actually reduce company-financed research efforts when awarded Government research contracts. The President's Commission on Industrial Competitiveness recently concluded: "In the years following World War II federally funded R&D projects were important catalysts to commercial industries such as aircraft and electronics. Today the roles have been reversed in many technologies." Spinoffs are—it is generally agreed—more likely for basic than for applied research. A detailed look at SDI, unfortunately, shows a strong bias toward specific application, including an emphasis on developing prototypes rather than basic research. While some SDI associated work—such as the development of very high speed integrated circuits [VHSIC]—has already begun to find commercial uses, private application of high-energy lasers, particle beams, large optics, and infrared sensors are not immediately obvious. Commercial benefits from the bulk of SDI research are at best speculative. Most disturbing of all is the shroud of secrecy surrounding SDI which may squelch commercial spinoffs entirely.

Even if advances potentially useful in the private sector do result from SDI, concern that the technologies could be copied by the Soviet Union is certain to prohibit dissemination of the new knowledge.

William D. Carey, executive secretary for the American Association for the Advancement of Science testified on the "chilling effect" of security concerns on technology transfer. "If the administration continues on its present course of imposing prior clearance and restraints on the disclosure of the results of unclassified research, in the name of shielding our science from Soviet bloc imitation, the good that can be done through Federal funding can be crippled by an officious bureaucracy."

Given the sensitivity of strategic defense efforts, the concern of the present administration about technological piracy, and experience to date, the security surrounding SDI is expected to be tighter than for most defense projects. For example, problems have already developed regarding the commercial uses of VHSIC's. Our study found that Defense Department restrictions on public disclosure information about VHSIC chips is so tight that "closeup, head-on photographs . . . cannot be published because of concerns that the Soviets might be able to determine the chip architecture and reverse engineer the device from such data."

The Soviet Union's ability to gain access to the technology could indeed be augmented if less restraint was imposed. But such secrecy also hinders commercial application of technologies developed by the military. Chip manufacturers may have to obtain security clearances for every employee, every visitor and some suppliers. Moreover, chip designs used by the military may have to be altered for use in civilian products. This prompted one manufacturer to ask: "How much must I change my VHSIC gate-array design to escape security restrictions?"

Many Europeans are also skeptical about how much they will benefit from spinoffs. Some have pointed to restrictions on high technology exports to Europe, as United States Defense officials fear such equipment will find its way to the Soviet Union. The Eureka project, on the other hand, while smaller than SDI, will provide direct support to civilian industries in development of integrated circuits, supercomputers, and software. A French-West German forum has already proposed at least six projects in these areas. Eureka, in addition, may well promote links to some areas of East-West technological cooperation, an activity of interest to Europeans that is not likely to emerge from the secret-ridden SDI Program. SDI contracts to Europe are limited by the provisions of the

ABM Treaty as well. As long as the United States is committed to abide by the ABM Treaty, agreed statement G prohibits European access to blueprints for ABM components thereby limiting both the types and amounts of contracts transferred from the United States.

The administration's case for accelerated strategic defense funding rests on the argument that it is impossible to criticize the proposal before the technologies are sufficiently explored for feasibility. But until the prospects for success are established, the case for accelerating a massive funding effort cannot be made.

Accordingly, the Council on Economic Priorities recommends: One, that the Defense Department reduce the strategic defense initiatives emphasis on developing prototype systems at least until the technological uncertainties of deploying an effective overall defense and its implications to the ABM Treaty have been clarified.

Two, that the Congress significantly slow SDI's funding growth rate unless and until a more complete analysis indicates that the goal is technologically feasible and strategically advantageous. The fiscal year 1987 budget request of $4.9 billion, a 78-percent increase, is clearly excessive. The political momentum that will develop as a result of an accelerated program should not be allowed to drive the Nation to develop defensive systems.

Three, SDI should be used as a bargaining chip to encourage the Soviet Union to accept substantial limits on offensive systems. As was recommended by a just released New York City Bar Association study chaired by Stanley Resor, and as many of us had hoped would materialize at Geneva, Prime Minister Margaret Thatcher's remarks Friday emphasized the four Camp David points of understanding which include provisions that deployment be a matter of negotiation with the Soviets.

Four, the House should also empower an independent review board to assess the economic implications of the program including costs, possible drain on scientific and engineering talent, possible skewing of our national research and development spending, crowding out, potential spinoffs, the effects of progress toward balancing the budget and the advisability of establishing offsets for the United States for SDI contracts going abroad, as recommended in an amendment proposed last session by Representative Foglietta, approved by the House, but dropped in joint conference. The program currently authorizes industries developing the "systems architecture" of a strategic defense system to determine whether research merits moving on to production and deployment.

These are the same firms that will be first in line to receive the contracts for production and deployment. An independent panel appointed by the House would hedge against this conflict of interest and would be complementary and essential to the findings of the National Academy of Sciences and the House Armed Services Committee studies of the strategic implications of the SDI.

Thank you, honored Members of the Congress.

[The prepared statement of Ms. Marlin follows:]

Testimony Before the Economic Stabilization Subcommittee of the House Banking Committee

Statement of Alice Tepper Marlin
December 10, 1985

Mr. Chairman, Members of the Committee, I am deeply grateful to you for the honor bestowed by your invitation to testify today.

If implementing President Reagan's vision of a space-based defense of our population could make nuclear war obsolete, it would be worth virtually any price. Even before establishing feasibility and strategic impact, however, the Congress is being asked to allocate a sums which are quite literally astronomical. The R&D stage alone is the largest military venture ever proposed.

Since planners have not even defined the architecture of a strategic defense system, estimates of cost necessarily range widely. Official estimates of full costs go from roughly $ 100 to $ 500 billion. By the Council on Economic Priorities' estimates, based on historical ratios to R&D costs, deployment of a strategic defense could run anywhere from $ 400 to $ 800 billion.

We can, of course, get a far narrower range of estimates for the R&D

stage, to determine what might be feasible. The Defense Department has already spent $ 2.3 billion in the last two years and plans to spend an additional $ 31 billion during the next six years on SDI research and development. That exceeds the research and production costs combined for major programs such as the MX missile and B-1 Bomber. And independent estimates range much higher.

While the US, with a GNP of $ 4 trillion, could finance programs of even this size, the strain would not be insignificant. Thirty-three billion dollars is certainly what Senator Dirksen would have called "real money". Cutting it could make a sizeable dent in the federal deficit. Keeping it without tax increases is likely to occur only at the expense of further cuts in civilian programs.

The rate of expenditure escalation is quite steep. As Table I indicates, SDI appropriations will increase 35.8 percent in constant dollars in FY 1985. During FY 1986, budget authority is slated to expand by almost 90 percent in real terms. While strategic defense research will require only a small portion of total national R&D, growth is so rapid that it may well "crowd out" other federal R&D efforts with less political clout.

Between 1984 and 1990, SDI is slated to grow from 3.7 to 13.1 percent of the DoD's total RDT&E budget. More importantly, SDI will consume 31.8 percent of the projected increase in national R&D spending in 1987.

Moreover, an expense of this magnitude involves substantial opportunity costs. Our SDI undertaking could disadvantage us in international competition by diverting scarce resources and prized technical talent into arcane avenues of research which lack good commercial potential.

The deep recession that began in 1981 ameliorated the tight job markets in computer science and engineering. However, high economic growth coupled with high defense spending over the next few years could again tighten labor markets for scientists and engineers according to the National Science Foundation. Though it is unlikely that jobs will go unfilled, increased demand for scientists and engineers in strategic defense programs could draw away appropriately trained and experienced personnel from other fields, reducing the effectiveness and efficiency of R&D in those areas.

There is some indication that on the basis of salary alone defense contractors are able to attract the best personnel, a palpable drain on commercial enterprise. In a survey of its membership in 1983, the Institute of Electrical and Electronic Engineers found the median salary of engineers working in aerospace and defense was significantly higher than the median engineering salary ($ 45,095 versus $ 40,000). On the other hand, salaries of new graduates going into aerospace are not substantially different than other fields. It is conceivable that up to 10 percent of the job openings for computer specialists and aeronautical/astronautical engineers may have to be filled by personnel transfers from other fields by 1987. For industries requiring these specialities, the high transfer rates could impose substantial costs, including more retraining, recruiting, and payroll expenses.

For the nation's defense contractors, however, the timing of SDI couldn't have been better. As production contracts for big ticket items like the B-1 Bomber and the MX missile wind down, SDI can secure their financial position for the decades to come.

In fact, the benefits of SDI will accrue overwhelmingly to the same regions and contractors that now depend on military spending. Over 90 percent of strategic defense and anti-satellite weapons contracts in 1983 and 1984 went to just four states - California (45%), Washington (22%), Texas (13%) and Alabama (10%). And despite assertions made by SDI officials that small innovative firms will get their fair share, the top ten SDI contractors got 87% of all awards through October 1984.

European governments, including those which have been the most supportive of the Reagan Administration's military policies, have questioned SDI's effects on Europe's national security needs. Yet in Europe, as in the US, electronics, aerospace and other technologically-oriented firms have moved rapidly to seek a piece of the Star Wars action.

Among European nations, only Britain and France possess an independent nuclear deterrent and neither can come close to matching the Soviet arsenal in either quantity or quality.

Ever since accepting the protection of the American nuclear umbrella, our NATO allies have been concerned about how the US would respond in the event of a crisis confined largely to Western Europe. Would the US use its nuclear arsenal to protect Europe and open itself to Soviet retaliation, or would the US hold back its weapons to deter the Soviet Union from escalating a European-based conflict? The possibility that the US would de-couple itself from Europe was one of the issues in the European debate on the deployment of Pershing II and Ground Launched Cruise missiles.

Europeans are also concerned about tying their national security policies to the ups and downs of US defense planning. European memories are long and European leaders still speak of Prime Minister Harold MacMillan's chagrin at having President Kennedy and Defense Secretary McNamara cancel the Skybolt missile program. What if a future administration should cancel SDI? What if Congress should give the go ahead now, but later cut back the system in its quest for budgetary balance?

Many Europeans point out that SDI, even if it were to be effective against long-range ICBM's and SLBM's, would not be very useful against short-range or low trajectory missiles, or nuclear-capable aircraft -- weapons likely to be used against European targets in the event of war. Because of these concerns, some European leaders have proposed that Europe have nothing to do with SDI, and instead develop its own program of research on space technology. This could take the form of a civilian effort, as in the Eureka program proposed by France and now gaining support thoughout Europe, or possibly even a military program investigating a purely European space-based defense system.

Since Secretary Weinberger publicly invited European companies to compete for SDI contracts, however, a number of Europe's most prominent defense and electronics firms have expressed interest and in some cases have opened discussions with the SDI program office. Fiat of Italy, Matra of France, Plessey and British Aerospace from the UK and Messerschmitt Boelkow-Blohm and Dornier of West Germany are only some of the European companies that are seeking SDI work, and the list could be readily expanded to include dozens, if not hundreds, of companies, non-profit and university-based research institutes, and individual consultants.

One reason is the fear of being left behind in the technological dust of the US and Japan. But it appears that the predominant reason European military contractors would jump at the chance to do business with the Pentagon can be captured in Willie Sutton's famous aphorism: "that's where the money is." Or as a British participant put it at the Wehrkunde Meeting of defense specialists in Munich earlier this year, "Our snouts are already twitching to get to the trough." I am aware of no offsets to the US for our SDI purchases abroad.

In contrast to the stratospheric budgets for our SDI, Eureka is currently viewed as a $ 5 billion project, and Europe would have to pay its own bills. Using US largesse has many potential advantages for contractors. European companies, in line with what has been the trend over the past five years, are hoping to forge long-term relationships with American firms, through joint ventures and subcontracting, as a means of gaining access to the entire US defense market in the 1990s.

These motives are sufficient to explain why business in the US and Europe would jump at the invitation to participate in the SDI program. Other more questionable rationales have been marshalled in support of the program - namely that SDI will result in valuable spinoffs that will benefit civilian technology and increase productivity. General James Abrahamson lists specific product areas to be benefitted by SDI spinoffs and has stated that such spinoffs can help SDI pay for itself. Yet predicting the extent and kind of eventual SDI spinoffs is a more difficult task than forecasting its full cost.

Defense officials continually state that the ultimate architecture of SDI will only emerge from the research and development process and cannot be predicted at present. Officials also are not capable of knowing what products and processes will be in demand in the 1990s, and whether the potential spinoffs from SDI will be sufficiently reliable and cost competitive for civilian markets. I must warn you, however, that SDI's performance requirements are so extreme that its technologies appear unlikely to find cost-effective uses in commercial products.

If the past is any guide, there will be spinoffs from SDI, as there have been from the space program and from previous large weapons procurement and research programs. 'But the past also suggests that the number of concrete examples will be few and the dollar benefits will be small in relation to the costs.

Most industry-level econometric analyses do not find that government-supported R&D improves economic efficiency. R&D sponsored by the firm themselves, on the other hand, tends to be strongly correlated with increased productivity. One study suggests that firms actually reduce company-financed research efforts when awarded government research contracts. The President's Commission on Industrial Competitiveness recently concluded:

> In the years following World War II, federally funded R&D projects were important catalysts to commercial industries such as aircraft and electronics. Today the roles have been reversed in many technologies.

Spinoffs are, it's generally agreed, more likely for basic than for applied research. A detailed look at SDI, unfortunately, shows a strong bias toward specific applications, including an emphasis on developing prototypes rather than basic research. While some SDI associated work— such as the development of very high speed integrated circuits (VHSIC) — has already begun to find commercial uses, private application of high-energy lasers, particle beams, large optics, and infrared sensors are not immediately obvious. Commercial benefits from the bulk of SDI research are at best speculative.

Most disturbing of all, the shroud of secrecy surrounding SDI may squelch commercial spinoffs entirely. Even if advances potentially useful in the private sector do result from SDI, concern that the technologies could be copied by the Soviet Union is certain to inhibit dissemination of the new knowledge. William D. Carey, Executive ~~Office of~~ Secretary for the American Association for the Advancement of Science testified on the "chilling" effect of security concerns on technology transfer:

> If the Administration continues on its present course of imposing prior clearance and restraints on the disclosure of the results of unclassified research, in the name of shielding our science from Soviet bloc imitation, the good that can be done through federal funding can be crippled by an officious bureaucracy.

Given the sensitivity of strategic defense efforts, the concern of the present Administration about technological piracy, and experience to date,the security surrounding SDI is expected to be tighter than for most defense projects. For example, problems have already developed regarding the commercial uses of VHSICs. Our study found that Defense Department restrictions on public disclosure of information about VHSIC chips is so tight that "close-up, head-on photographs ... cannot be published because of concerns that the Soviets might be able to determine the chip architecture and reverse engineer the device from such data."

The Soviet Union's ability to gain access to the technology could indeed be augmented if less restraint was imposed, But such secrecy also hinders commercial application of technologies developed by the military. VHSIC chip fabricators, for instance, may have to obtain security clearances for every employee or visitor and some suppliers. Moreover, chip designs used by the military may have to be altered for use in civilian products. This prompted one manufacturer to ask: "How much must I change my VHSIC gate-array design to escape security restrictions?"

Many Europeans are also skeptical about how much they will benefit from spinoffs. Some have pointed to restrictions on high technology exports to Europe, as US Defense officials fear such equipment will find its way to the Soviet Union. The Eureka project, on the other hand, while smaller than SDI, will provide direct support to civilian industries in development of integrated circuits, supercomputers, and software. A French-West German forum hás already proposed at least six projects in these areas. Eureka, in addition, may well promote links to some areas of East-West technological cooperation, an activity of interest to Europeans that is not likely to emerge from the secret-ridden SDI program.

SDI contracts to Europe are limited by the provisions of the ABM Treaty. As long as the US is committed to abide by the ABM Treaty, Agreed Statement G prohibits European access to blueprints for ABM components, thereby limiting both the types and amount of SDI contracts transferred from the US.

The Administration's case for accelerated strategic defense funding rests on the argument that it is impossible to criticize the proposal before technologies are sufficiently explored for feasibility. But until the prospects for success are established, the case for accelerating a massive funding effort cannot be made. Accordingly, the Council on Economic Priorities recommends:

I. That the Defense Department reduce SDI's emphasis on developing prototype systems at least until the technological uncertainties of deploying an effective overall defense and its implications to the ABM Treaty have been clarified.

II. That the Congress significantly slow the SDI's funding growth rate unless and until a more complete analysis indicates that the goal is technologically feasible and strategically advantageous. The FY 1987 budget request of $ 4.9 billion, a 78 percent increase, is clearly excessive. The political momentum that will develop as a result of an accelerated program should not be allowed to drive the nation to develop defensive systems.

III. SDI should be used as a bargaining chip to encourage the Soviet Union to accept substantial limits on offensive systems, as recommended by a just-released NYC Bar Association Study chaired by Stanley Resor and as many had hoped would materialize at Geneva. Prime Minister Margaret Thatcher's remarks Friday emphasized the four Camp David points of understanding which include provisions that deployment be a matter of negotiation with the Soviets.

IV. The House should empower an independent review board to assess the economic implications of the program including cost, the possible drain on scientific and engineering talent, skewing of R&D spending, crowding out, potential spinoffs, the effect on progress towards balancing the budget and the advisability of establishing offsets for the US for SDI contract dollars going abroad, as recommended in an amendment proposed last session by Representative Foglietta, approved by the House, but dropped in Joint Conference.

The program currently authorizes industries involved in developing the "systems architecture" of a strategic defense system to determine whether research on SDI merits moving on to production and deployment. The independent panel would hedge against this conflict of interest. A panel to study the economic implications will be complementary and essential to the findings of the NAS and House Armed Services Committee studies of strategic implications of SDI.

Thank you, honored members of the Congress.

ABLE 1: SDI GROWTH AS A PERCENTAGE OF R&D GROWTH
(Millions of constant 1986 dollars of budget authority)

	1984	1985	1986	1987	1988	1989	1990	1985-90 Total
DI - Current Year	$1,070	$1,453	$2,750	$4,701	$5,649	$6,418	$7,326	$28,297
DI - Previous Year	1,042	1,070	1,453	2,750	4,701	5,649	6,418	22,042
DI Growth	29	383	1,297	1,951	948	769	908	5,348
Percent	2.78	35.76	89.23	70.94	20.17	13.61	14.14	24.26
DT&E - Current Year	$28,992	$32,731	$35,489	$40,792	$45,157	$49,144	$55,779	$259,091
DT&E - Previous Year	26,028	28,992	32,731	35,489	40,792	45,157	49,144	232,304
DT&E Growth	2,965	3,739	2,758	5,303	4,365	3,987	6,635	26,787
DI Growth as a Percentage of DT&E Growth	.98	10.24	47.01	36.79	21.72	19.29	13.68	19.96
tional R&D - Current Year	$104,646	$110,183	$116,014	$122,154	$128,618	$135,425	$142,592	$754,987
tional R&D - Previous Year	100,099	104,646	110,183	116,014	122,154	128,618	135,425	717,041
tional R&D Growth	4,547	5,538	5,831	6,140	6,464	6,807	7,167	37,946
DI Growth as a Percentage of tional R&D Growth	.64	6.91	22.24	31.77	14.67	11.30	12.67	14.09

ABLE 2: SDI RDT&E AS A PERCENTAGE OF R&D
illions of dollars of budget authority)

	1984	1985	1986	1987	1988	1989	1990	1985-90 Total
trategic Defense Initiative	992	1,397	2,750	4,910	6,166	7,300	8,657	31,180
otal Department of Defense DT&D	26,867	31,464	35,489	42,607	49,289	55,896	65,914	280,659
I as a Percentage of Total DoD RDT&D	3.69	4.44	7.75	11.52	12.51	13.06	13.13	11.11
tal National R&D	96,975	105,919	116,014	127,590	140,387	154,032	168,501	812,444
I as a Percentage of tal National R&D	1.02	1.32	2.37	3.85	4.39	4.74	5.14	3.84

Mr. **Vento**. Thank you.

I understand you do not have a conflict in schedule now, so I would move ahead to Mr. Pike's testimony and question both of you at the same instance.

Is that acceptable?

Ms. **Marlin**. If I can leave by 10 after 4, will that be OK?

Mr. **Vento**. I think we can move ahead and let you summarize your testimony, Mr. Pike.

I have been looking at it; it is excellent. Then we will move into questions and Ms. Marlin has to leave.

Please proceed.

STATEMENT OF JOHN PIKE, ASSOCIATE DIRECTOR FOR SPACE POLICY, FEDERATION OF AMERICAN SCIENTISTS

Mr. **Pike**. Thank you very much.

Mr. Chairman, members of the committee, I would like to express my gratitude for the honor of being asked to testify here this afternoon. I think it is increasingly clear that the issues addressed by this subcommittee are central to the SDI debate.

At first glance, the SDI would seem to be a product made in and for America, with little attraction for our allies. Western European leaders who express considerable skepticism about the President's star wars plan, leaders from various NATO nations, have argued the SDI would fuel the arms race, endanger existing arms control agreements, and make new agreements more difficult to achieve, creating a "fortress America" mentality.

This decoupling of United States and European security would divide the alliance. European awareness of the SDI could undermine support for the American negotiating position in Geneva leading to calls to trade in star wars for reductions in offensive forces.

In an effort to shore up allied support for the program earlier this year, Secretary Weinberger offered our allies the opportunity to participate in the program. The United Kingdom is the first to sign a formal agreement and similar arrangements expected over the next several months with the Federal Republic of Germany and with Italy.

This process has created an expectation in Europe of significant participation by European defense companies in the strategic defense initiative.

Altogether, as much as $3 billion is expected by the Europeans to flow across the Atlantic. In reality, there are a number of barriers to significant allied participation in the SDI.

We have just completed a detailed analysis of the SDI budget for 1986 through 1990, and concluded that the cumulative effect of all of these barriers is substantial. While European companies will probably get about $30 million in contracts fairly soon, they are unlikely to get more than $300 million over the next 5 years and will almost certainly fail to realize their expectation of $3 billion.

The alternative is a significant effort by the administration to change the rules to facilitate greater European participation in the SDI. Perhaps this has been the case with the recent memorandum of understanding with the British.

However, the secrecy of this agreement makes it very difficult to assess this question. If special procedures are established for the SDI, the Congress should carefully examine these to determine their consistency with established policies in this area.

There are at least six current barriers to significant European participation in the SDI and dollar value of these is summarized in figure 2 on page 4 of my testimony.

The ABM treaty will preclude European participation in almost half of the SDI Program. The limited capabilities of European companies in specialized technologies of the SDI renders another third of the program budget beyond their reach.

About $4 billion of the program will go for research with potential commercial application, and the United States is unlikely to fund European competition to American companies.

Another $1 billion covers work, such as maintenance of facilities that by its very nature must be done in the United States by American companies.

European corporations could bid on the remaining $1 billion of SDI contracts, but in competition with U.S. companies they are unlikely to win a majority of these contracts. And special set-asides for non-U.S. companies will remain very small.

I would like to review very briefly the six barriers we discovered to European participation in the SDI.

Almost half of the SDI Program consists of work on the development and testing of antimissile components limited by the ABM treaty. The treaty specifies in article 9 that each part undertakes not to transfer to other states ABM systems or their components limited by this treaty.

The treaty further states in agreed statement G that the obligations of the treaty include the obligation not to provide to other states technical descriptions or blueprints specifically worked out for the construction of ABM systems and their components limited by the treaty.

These treaty limitations would effectively preclude European participation in such major SDI projects as space-based, air-based, and ground-based censors, space-based, and ground-based rocket interceptors and directed energy weapons.

The second major barrier to European participation in the SDI is the limited capabilities of European companies. As much as one-third of the SDI budget, over $10 billion, will go for research into technologies with which European companies have relatively little expertise.

The United States has been doing work on ABM systems for almost 10 years. For almost 30 years spending over $50 billion during this period. This has created a substantial industrial base in antimissile technology in the United States that is lacking in Europe.

The European competitive disadvantage is illustrated by the almost total absence of non-U.S. firms in ABM and SDI contracting to date. This situation is summarized in figure 3 on page 7 of my testimony.

Since President Reagan delivered the star wars speech on March 23, 1983, over 1,000 contracts worth more than $3 billion have been signed. All of these contracts are with American companies.

A review we conducted of Army ABM contracts over the decade 1975–85 reveals a similar number of contracts with about the same value, about 1,000 contracts worth about $3 billion and not a single Army prime contract was awarded to European companies.

The United States imposes strict limitations on the export of advanced military systems. This process places significant limitations on the ability of allied countries to obtain access to these technologies and these would impede European collaboration in the SDI.

Dr. Yonas previously mentioned potential germane cooperation in the area of optical systems. European optical companies may have a hard time bidding on SDI contracts since the 1983 determination by the Defense Department that the American optical industry was in a state of decline and in need of protection.

The application of the "Buy American" policy to the optical industry has led to the virtual exclusion of non-U.S. optical firms from defense contracts.

The third barrier that we identified is the commercial potential of some SDI technology. However, the SDI will probably not have significant commerical benefits but to the extent that it does, European companies are unlikely to receive contracts with spin-off potential.

It is unlikely that the Congress would look favorably on using SDI money to subsidize European competition for American companies. Some Europeans speculate about the possibility of SDI contracts aiding the development of their computer industry. But this is not a likely result of the SDI. But to the extent that it might be, the American political system would be unlikely to tolerate such a development.

Thus, in the area of computer hardware and software as well as space transportation and other areas with potential for commercial development, European corporations are unlikely to obtain significant SDI contracts.

This is also true for the basic research efforts of the SDI's innovative science and technology office, since it is unclear that the SDI should be fostering the progress of basic science in other countries. It is clear that the SDI is unlikely to be turned into a second Marshall plan for the renovation of European industry.

The fourth barrier we identified again was the approximately $1 billion of SDI contracts that by their nature must be done in the United States, such as maintenance of research facilities.

The fifth barrier is the competitive environment.

Given all of these other barriers, there is only about $1 billion of the SDI that European companies would be eligible to bid for.

As I said, these contracts will be eagerly sought by many qualified American companies as well, and thus it would be quite surprising if European companies won as much as a third of these contracts; at most, $300 million over a 5-year period.

The most visible SDI contract in Europe will probably be the award next spring of a contract worth perhaps $10 or $20 million for support of an SDI sensor experiment on the shuttle flight in 1987. However, these preferences to European contractors may disadvantage U.S. firms as well as the rate of progress in the SDI Program.

I would like to conclude by noting that these barriers substantially limiting the potential for European participation in the SDI are not the result of bureaucratic caprice or historical accident, but of considered national policy.

There have already been some informal discussions in the Congress of possible measures in response to the recent memorandum with the British. There is not enough information available today on the details of the memorandum of understanding to determine which of these initiatives might be called for.

There is clearly an aim to look more closely at allied collaboration in SDI, and I think today's hearing is a very important first step in that direction.

Thank you.

[The prepared statement of Mr. Pike follows:]

BARRIERS TO EUROPEAN PARTICIPATION IN THE STRATEGIC DEFENSE INITIATIVE

STATEMENT OF

JOHN PIKE

ASSOCIATE DIRECTOR FOR SPACE POLICY
FEDERATION OF AMERICAN SCIENTISTS

TO THE

SUBCOMMITTEE ON ECONOMIC STABILIZATION
COMMITTEE ON BANKING, FINANCE & URBAN AFFAIRS
HOUSE OF REPRESENTATIVES

10 DECEMBER 1985

2:00 PM

ROOM 2128 RAYBURN HOUSE OFFICE BUILDING

BARRIERS TO EUROPEAN PARTICIPATION
IN THE
STRATEGIC DEFENSE INITIATIVE

Mr. Chairman, Members of the Committee, I would like to express my gratitude for the honor of being asked to testify this afternoon. Although the Strategic Defense Initiative is frequently regarded as the domain of other Committees of the Congress, I think that it is increasingly clear that the issues addressed by this Sub-Committee are central to the SDI debate.

I appear befor this Committee today not as an authority on Defense procurement procudures or the insitutional history of the Two-Way Street debate, but rather as someone who has looked intensively in the last few months at the current state of Strategic Defense Initiative contracts.

The recent signing of a Memorandum of Understanding between the U.S. and the United Kingdom on participation in the SDI opens a new chapter in the Star Wars saga.

At first glance, the SDI would seem to be a product made in and for America, with little attraction for our Allies. Western European leaders have expressed considerable skepticism about the President's Star Wars plan. Leaders from various NATO nations have argued that the SDI would fuel the arms race, endanger existing arms control agreements and make new agreements more difficult to achieve, and create a "Fortress America" mentality where American leaders would perceive their security as separate from the security of Western Europe. This "decoupling" of U.S. and European security would divide the Alliance and force West European nations to seek alternative security arrangements.

European wariness of the SDI could undermine support for the American negotiating position in Geneva, leading to calls to trade in Star Wars for reductions in offensive forces.

In an effort to shore up Allied support for the program, earlier this year Secretary Weinberger offered our Allies the opportunity to participate in the program. To date, Australia, Canada, Denmark, France, and Norway have declined formal inter-governmental participation in the SDI, while indicating that private companies were free to bid on SDI contracts. The United Kingdom is the first to sign a formal agreement, and similar agreements are expected over the next several months with the Federal Republic of Germany and with Italy. Negotiations are also underway with several other Allied countries.

FIGURE 1

EUROPEANS EXPECT TO GET 10% OF ALL SDI CONTRACTS

United Kingdom	$ 1,500,000,000
Federal Republic of Germany	$ 1,000,000,000
OTHER COUNTRIES (estimate)	$ 500,000,000
TOTAL EXPECTATION	$ 3,000,000,000

"There are still several billion dollars yet to go"

Secretary of Defense Caspar Weinberger
Bonn, Federal Republic of Germany
2 December 1985

SDI CONTRACTS & EUROPEAN CONTRACTORS - A SUMMARY

TOTAL SDI PROGRAM 1986-90	$ 30,000,000,000	100.0%
EUROPEANS EXPECT TO RECEIVE	$ 3,000,000,000	10.0%
EUROPEANS MIGHT RECEIVE *	$ 300,000,000	1.0%
EUROPEANS GUARANTEED	$ 30,000,000	.1%

* Assumes that European companies win 1/3 of the contracts that they are eligible to bid for under current procedures.

This process has created an expectation in Europe of significant participation by European defense companies in the SDI. All together, as much as $ 3 Billion is expected to flow across the Atlantic (Figure 1). These expectations have been fueled by various statements by Administration officials.

However, during the course of the recent negotiations, the U.S. refused a British request for a commitment of $1.5 billion for British companies, saying only that the level of participation would be "substantial." This American reluctance is quite understandable, since the actual amount of money that British companies are likely to receive will probably be only a fraction of the requested amount.

In reality there are a number of barriers to significant Allied participation in the SDI. We have conducted a detailed analysis of the SDI budget for 1986-90, and conclude that the cumulative effect of all of these barriers is substantial. While European companies will probably get $30 million in contracts fairly soon, they are unlikely to get more than $300 million over the next five years, and will almost certainly fail to realize their expectations of $3 billion.

The political repercussions of these failed expectations cannot help but further reduce European support for the SDI and the Administration's current posture at the Geneva arms control negotiations.

The alternative is a significant effort by the Administration to change the rules to facilitate European participation in the SDI. The very limited publicly available information on the Memorandum signed by with the British does not allow an assessment of whether such changes are contemplated.

But if special procedures are established for the SDI, the Congress should carefully examine these to determine their consistency with established policies in this area.

BARRIERS TO PARTICIPATION

There are at least six current barriers to significant European participation in the SDI (summarized in Figure 2). The ABM Treaty will preclude European participation in almost half of the SDI program. The limited capabilities of European companies in the specialized technologies of the SDI renders another third of the program beyond their reach. Over $ 4 billion of the program will go for research with potential commercial applications, and the United States is unlikely to fund European competition to American companies. Another $ 1 billion covers work, such

FIGURE 2

BARRIERS TO EUROPEAN PARTICIPATION IN THE SDI

TOTAL SDI PROGRAM 1986-1990	$ 30 Billion
CONTRACTS CONSTRAINED BY :	
1 - THE ABM TREATY	$ 14 Billion
2 - CAPABILITIES OF EUROPEAN COMPANIES	$ 10 Billion
3 - COMMERCIAL POTENTIAL OF SDI	$ 4 Billion
4 - WORK PERFORMED IN THIS COUNTRY	$ 1 Billion
TOTAL NOT AVAILABLE TO EUROPEAN COMPANIES	$ 29 Billion
5 - AVAILABLE FOR COMPETITION	$ 1 Billion
6 - FOREIGN PREFERENCE PROGRAMS	$ 30 million

as maintenance of facilities that by its nature must be done in the U.S. by American companies. European corporations could bid on the remaining $ 1 billion of SDI contracts, but in a competition with U.S. companies they are unlikely to win a majority of these contracts. And special set-asides for non-U.S. companies will remain very small.

BARRIER # 1 - THE ANTI-BALLISTIC MISSILE (ABM) TREATY OF 1972

The first barrier to the participation of European corporations in the SDI is the Anti-Ballistic Missile Treaty of 1972. Almost half of the SDI program consists of work on the development and testing of anti-missile components limited by the ABM Treaty. In addition to limits on the testing and deployment of these components, the Treaty also specifies that:

> "... each Party undertakes not to transfer to other states ... ABM systems or their components limited by this Treaty." (**Article IX**)

The Treaty further defines this to include the obligation:

> "... not to provide to other States technical descriptions or blue prints specially worked out for the construction of ABM systems and their components limited by the Treaty." (**Agreed Statement G**)

The Treaty limitations apply only to ABM components that currently consist of interceptors and radars, and to components based on other physical principles capable of substituting for these components in the future. However, the Treaty does not place limitations on ABM computers, and thus would pose no barrier to cooperation in this area.

But the Treaty limitations on the transfer of ABM components and plans for such components would effectively preclude European participation in such major SDI projects as space-based, air-based and ground-based sensors, space-based and ground-based rocket interceptors, and directed energy weapons. This prohibition would even apply to the Low Endo-atmospheric Defense Interceptor (LEDI), which has been proposed for defense against tactical missiles in Europe, since LEDI is also being developed to defend American ICBM silos against strategic missiles, and is thus subject to the ABM Treaty's limitations. It is difficult to imagine how non-U.S. corporations could join in these projects without access to "technical descriptions or blue prints."

These companies could perhaps work as subcontractors, building very small devices and subsystems, but the total dollar value of such work would be trivial. Although European companies could perhaps perform basic research in areas such as directed energy weapons, they would be precluded from following up their initial research efforts with more substantial (and lucrative) development and testing contracts. Although the United States might benefit by skimming the cream of European industry, European companies and governments would probably find this an unattractive prospect.

Although the Administration has shown a casual disregard for the letter of the ABM Treaty, adherence to the so-called "restrictive" interpretation of the Treaty would also include compliance with the Article IX and Agreed Statement G restrictions. There has been no indication that yet another re-interpretation of the Treaty is in the offing.

All European nations, but especially France and Great Britain, have a strong interest in preserving the ABM Treaty and have staunchly supported the Treaty since its inception. The ABM Treaty prevents Soviet deployment of an ABM system that, while ineffective against U.S. strategic forces, could be more useful in protecting the U.S.S.R. from British and French retaliation. European leaders, notably British Foreign Minister Sir Geoffrey Howe, have made compliance with the ABM Treaty a key condition for their support of the SDI.

Even if the American government is prepared to sacrifice the Treaty on the altar of European participation in the SDI, it is far from clear that European governments will go along with the process.

BARRIER # 2 - THE LIMITED CAPABILITIES OF EUROPEAN COMPANIES

The demanding requirements of defense against ballistic missiles will place additional limitations on European participation in the SDI. As much as one-third of the SDI budget, over $10 billion, will go for research into technologies with which European companies have little expertise. The United States has been doing work on ABM systems for almost 30 years spending over $50 billion during this period. This has created a substantial industrial base in anti-missile technology in the U.S. that is lacking in Europe.

The European competitive disadvantage is illustrated by the almost total absence of non-U.S. firms in ABM and SDI contracting to date (Figure 3). Since President Reagan delivered the Star Wars speech on 23 March 1985, over 1000 contracts worth more than $3 billion have been signed. All of these contracts are with American companies. The only case of non-U.S. participation in an SDI contract to date is a small subcontract that Plessy in the United Kingdom has signed with Boeing. A review of Army ABM contracts over the decade 1975-85 reveals a similar number of contracts with about the same value. Not a single Army prime contract was awarded to a European company.

Since the ABM Treaty was signed in 1972, there have been literally thousands of contracts worth perhaps $10 billion signed with hundreds of companies in the U.S. We have been able to identify only two very small contracts, worth no more than $10 million, that were awarded to European companies, both of which, ironically, are French. The Navy bought a 2 meter diameter mirror from RESOC (Reserches et Etudes d'Optique et de Sciences Conexes) and the Army shipped a sample radar antenna face to France to be tested in a solar furnace for vulnerability to nuclear explosions.

FIGURE 3

EUROPEAN PARTICIPATION - THE RECORD

SOURCE	PERIOD	ALL CONTRACTS TOTAL VALUE	EUROPEAN CONTRACTS	EUROPEAN SHARE
SDI	1983-85	$ 3,000,000,000	$ 0	0.0%
Army BMD	1975-85	$ 3,000,000,000	$ 0	0.0%
SDI & related	1972-85	$10,000,000,000	$10,000,000	0.1%

Although tactical European military systems are the equal of many of their American counterparts, expertise in tactical weapons does not necessarily carry over to strategic weapons. European experience with small short-range tactical radars provides little basis for working with very large phased array radars capable of tracking thousands of missile warheads at distances of thousands of kilometers. European work on small heat-seeking missile guidance components with dozens of sensor elements has little application to the production of anti-missile sensors with millions of sensor elements. The guidance and propulsion technology developed for short-range rockets by European companies fall far short of the requirements posed by anti-missile interceptors, whose acceleration, speed and range must all be over an order of magnitude greater.

Several countries, such as the Federal Republic of Germany, do have small programs for the development of directed energy weapons. However, these efforts lag the United States by over a decade. Recently plans were unveiled by one German firm for a mobile anti-aircraft laser mounted on a tank chasis. It was stated that several years would be required to complete development of the initial test model. The United States first tested such a system in the mid-1970's.

The United States imposes strict limitations on the export of advanced military systems through such means as the "Militarily Critical Technology List," which includes virtually the entire SDI. These technologies are subject to strict licensing and controls to prevent their export to Soviet bloc countries. This process places significant limitations on the ability of Allied countries to obtain access to these technologies, and would impede European collaboration in the SDI. Special clearances are need for European nationals to gain access to U.S. facilities, and the June 1983 Report of Defense Science Board Task Force on Industry-to-Industry International Armaments Cooperation noted that:

> "Cumbersome and lengthy security procedures are a significant impediment to technical exchange and cooperation. ... Bureaucratic and overly protective security procedures can thwart the best intentions to cooperate by imposing time delays and by rendering the technical exchange required for industrial cooperation difficult, or even impossible."

The limited capabilities of European companies also have implications for contracting procedures, which are governed by Department of Defense Directive 2010.6 (5 March 1980) "Standardization and Interoperability of Weapons Systems and Equipment within the North Atlantic Treaty Organization." This directive notes that non-U.S. contractors would not be allowed to pre-solicitation and other briefings preparatory to awarding contracts:

> "In any case when it can be established that the expertise residing in firms in (other) countries is not sufficiently advanced to allow a reasonable expectation of winning a competition... informal discussions should be initiated with representatives of these countries in the U.S. Often, such discussions will result in agreements that such acquisitions are not suitable prime contract opportunities for such foreign contractors."

This would seem to apply to much of the SDI.

There are additional procedural difficulties. Some are relatively minor, such as the fact that announcements of contract competitions are only sent to companies that the contracting agency believes are qualified to bid on the contract, with all other interested parties having to go to the office of the agency to get a look at the announcement. Other restrictions are more serious. European optical companies may have a hard time bidding on SDI contracts since the 1983 determination by the Defense Department that the American optical industry was in a state of decline, and in need of protection. The application of the "Buy American" policy to the optical industry led to the virtual exclusion of non-U.S. optical firms from Defense contracts.

BARRIER # 3 - THE COMMERCIAL POTENTIAL OF SOME SDI TECHNOLOGY

The SDI is unlikely to have significant commercial benefits, but to the extent that it does, European companies are unlikely to receive contracts with spinoff potential. The SDI will be developing technologies that are irrelevant to commercial applications, under conditions of strict military secrecy. Most of the SDI research with civilian applications is already under development by civilian companies. There is in fact a limited demand for some of these exotic technologies, either from the commercial or military sectors.

Nonetheless, advocates still claim that the SDI will produce a number of commercial spinoffs. To the extent that these claims are believed, it is unlikely that the Congress would look favorably on using SDI money to subsidize European competition for American companies. Some Europeans speculate about the possibility of SDI contracts aiding the development of their computer industry. This is not a likely result of the SDI, but to the extent that it might be, the American political system would be unlikely to tolerate such a development.

Thus in the areas of computer hardware and software, as well as space transportation and other areas with the potential for commercial development, European corporations are unlikely to obtain significant SDI contracts. This is also true for the basic research efforts of the SDI's Innovative Science and Technology Office, since it is unclear the the SDI should be fostering the progress in basic science in other countries.

This does not mean that there will be signficant civilian spinoffs from the SDI, or that the SDI could be supported on the basis of such spinoffs. But much has been made of the potential commercial value from the SDI, and advocates have recalled the space program and early military contributions to civilian industry. In fact, these precedents suggest that the SDI is unlikely to have significant civilian benefits.

The military did lead the way in the introduction of commercial jet aircraft and miniaturized computers, but these contributions were based on factors irrelevant to the SDI. The Air Force bought large numbers of KC-135 tankers, enabling Boeing to reduce the production costs of the 707 passenger jet. The Minuteman ICBM program was the first major customer for electronic chips, enabling the electronics industry to lower costs and improve production techniques. But in both of these cases, the impact of the military was as a purchaser of production items. The SDI research program will not make this type of contribution.

The United States spent over $75 billion on the Apollo moon program alone, but the major commercial spinoffs were Tang, Velcro, and Corning Ware. The moon program was not justified on the basis of these spinoffs, nor should the SDI be justified in this way.

Indeed the SDI may have a negative effect on the American economy. At the macro-economic level, the growth of the SDI budget will complicate efforts to reduce the Federal deficit. Economists have long noted that countries with high levels of military spending generally have lower growth rates than those with lower military burdens. In a sense the SDI is part of a trend toward remaking the American economy along the lines of that of the Soviet Union, at a time when increasing numbers of business leaders recognize the need to emulate the Japanese model of lower military spending and higher economic growth.

In some areas of interest to the SDI, such as supercomputer programmers and optical engineers, shortages of trained personnel already exist, and these would be exacerbated by the SDI. The SDI's short-term infusion of large amounts of cash may drive up the salaries of some favored technicians, but it is unlikely to expand the pool of talent. Instead, scientists and engineers will move from more beneficial endeavors to work on the SDI.

The specific economic benefits that have been claimed for the SDI are greatly exaggerated. To begin with, the SDI will stress the development of performance parameters that have limited relevance to the civilian world. Star Wars computers must be able to survive the effects of nuclear explosions, and so the SDI is putting money into research on radiation-hardened Gallium Arsenide computer chips. But banks and insurance companies don't need computers that can continue working during World War III. Directed energy systems can also have industrial and medical uses. But the military needs weapons with power outputs of many millions of Watts that will operate for a few minutes, whereas civilian tools must operate for months or years at powers of only a few Watts. X-ray lasers could be used in medical research or the production of computer chips, but the SDI is working on X-ray lasers powered by nuclear explosions, and no hospital or factory is going to detonate atomic bombs in its basement on a regular basis.

Another difficulty with finding commercial applications for SDI technology stems from the classification restrictions on military research. Much of the SDI will be highly classified, and thus unavailable for commercial development. Precedent for such problems is found in the Defense Department's Very High Speed Integrated Circuit (VHSIC) program, which has developed new computer chips that are much faster than existing models. But the program is so highly classified that companies working on VHSIC are prohibited from even publishing photographs of the new chips.

In addition, many of the technologies that are claimed to have commercial applications are already in development by civilian companies. Computers are frequently mentioned as one area of potential spinoff to the commercial sector. But the Defensive Technology Study Team (the Fletcher Panel) noted in its report on SDI computing requirements that the computer speeds required for missile defense would be available in civilian computers in the 1990's and that there was no need for the SDI to develop its own computers. There are seven commercial Gallium Arsenide computer chip production lines in the U.S. in addition to the one run by the SDI. And several companies not involved in the VHSIC program have produced commercially available equivalents of these high-speed chips, and have published pictures to prove it. Although the SDI has expressed an interest in the development of ultra-fast optical computers that use photons of light rather than electrons to store and process information, but there are already a number of civilian researchers at major laboratories working in this area.

The SDI spinoff argument also assumes a supply-side model of technological innovation in which the introduction of a new technology creates a new market. In fact, in many cases, the introduction of new technologies is largely governed by market demand. Great reductions in the cost of space transportation is also seen by some as a potential commercial contribution of the SDI. But there is already a over-supply of space launch services, indicated by the intense competition between the Shuttle and the European Ariane. American companies failed in their effort to find a commercial market for existing expendable launch vehicles, and have turned to the Defense Department as a customer of last resort. Lowering the cost of placing satellites in orbit would have a marginal impact on the commercial development of space. The main problem facing the space industry today is the lack of demand. The market for communications satellites has not expanded at predicted rates, and there is a glut of these satellites. Recently Mexico launched its Morelos communications satellite on the Shuttle, even though the satellite will not be placed in operation until 1989, because it was cheaper to store it in space than in a hanger on the ground. Materials processing and resource monitoring in space have failed to develop as viable industries, not because of high launch costs, but because of the lack of market demand.

One additional indication of the limited commercial potential of the SDI can be seen in the limited military applications of some of these projects. Arcane technologies that are unable to find military missions are unlikely to fare better in the civilian sector.

Many of the projects in the SDI are not new weapons, but have in fact been under development for many years, although for applications other than missile defense. However, these systems were far too advanced for these other applications, and had failed to receive approval for actual deployment. In a sense, the SDI has become a technological orphanage. By incorporating these projects into Star Wars, with its formidable operational requirements, these systems have gained a new lease on life.

The Space Based Imaging Radar Project is the Star Wars incarnation of the Air Force Space Surveillance Technology Project. Research on the technology involved in this Project has been under way for a number of years. However, very high costs, uncertain performance, platform vulnerability, coupled with the availability of more cost effective alternatives, have precluded deployment. The Navy considered deploying such a system under the Clipper Bow project, was since be re-oriented into the less ambitious Integrated Tactical Surveillance System (ITSS).

The Imaging Laser Project is based on the previous work done on the use of Blue-Green lasers for detection of submarines by the disturbances they cause in the optical scattering layer of particulate debris that is located several hundred feet under the ocean's surface. However, after several years of work, it became clear that this technique was not very useful for detecting submarines.

The Booster Surveillance and Tracking System is the new name for the Advanced Warning System. However, during 1984 the Air Force decided that the improved resolution afforded by the technology under development in the Advanced Warning System project was far in excess of that required for the early warning mission. Very accurate determination of boost-phase trajectories was determined to provide little improvement over existing systems in warning of launch or impact point prediction.

The Space Surveillance and Tracking System was formerly known as the Space-Based Surveillance System. This system was originally intended to support the new Air Launched Miniature Vehicle ASAT, as well as more advanced high altitude ASAT systems. However,less costly near-term radar upgrades were determined to provide a more cost effective alternative.

This is not to say that European participants in SDI research might not pick up some skills that could be turned to other purposes. But the possible development of commercial or non-strategic military products cannot be used to justify the SDI for the

United States. However, it is clear that the SDI is unlikely to be turned into a second Marshall Plan for the rennovation of European industry.

BARRIER # 4 - SOME OF THE WORK MUST BE PERFORMED IN THIS COUNTRY

About $ 1 billion of the SDI consists of activities, such as management support, that by their nature must be performed in the United States. Non-U.S. companies are unlikely to bid on such contracts, and would be unlikely to receive these contracts even if bids were made.

This estimate of $1 billion is conservative, since many other contracts, particularly those dealing with directed energy weapons, are for support of activities at U.S. facilities. For example, most of the work on Free Electron Lasers is done at Livermore and Los Alamos National Laboratories, and it might be difficult for European contractors to make a significant contribution to these efforts. These contracts would also have to be executed in the U.S., and European companies would be at a severe disadvantage.

BARRIER # 5 - THE COMPETITIVE ENVIRONMENT

Given all these barriers, there is only about $1 billion of the SDI that European companies would be eligible to bid for. This estimate of $1 billion is based on the list of 18 areas of opportunity that are reported to be part of the Memorandum signed by the British government. However, these contracts will be eagerly sought by many qualified American companies as well. And in many cases the U.S. company will enjoy various competitive advantages. Thus it would be surprising if European companies won as much as a third of these contracts, at most $300,000,000 over a five year period. In reality, the total could be much less.

BARRIER # 6 - THE PENALTIES OF FOREIGN PREFERENCES

Recognizing the many barriers facing European companies, the SDI has established at least two areas where non-U.S. contractors are virtually guaranteed a piece of the action. Several European contractors will be paid to study possible architectures for anti-tactical missile defense of NATO. The total value of these studies is unlikely to exceed $5 million, and their principal value will be to develop a more credible sales pitch for Star

Wars in Europe.

The most visible SDI contract in Europe will be the award next spring of a contract worth perhaps $10 or $20 million for support of SDI sensor experiments on a Shuttle flight in 1987. This is part of a special set-aside in the SDI budget for international programs. A total of 33 bids have been received, including five from European companies and two that are joint proposals. Sperry has teamed with the German firm of Dornier to offer Dornier's Instrument Pointing System (IPS) which recently flew on the Shuttle as part of the Spacelab D-1 mission. Boeing has teamed with the German firm of Messerschmitt-Boelkow-Blohm (MBB), which is proposing the use of the SPAS free-flying satellite to carry the SDI sensors. Lockheed is also proposing a stripped-down version of its TALON GOLD pointing and tracking system to support this mission.

Although it is likely that one of the German/American teams will win the competition, the award may prove controversial. The Boeing/MBB proposal would provide a platform for the sensor experiments, but it would not answer the critical question of whether the sensors can be isolated the from the vibration of the spacecraft, since the SPAS satellite would float free of the Shuttle. The Sperry/Dornier IPS could provide answers to this question, but the IPS performed poorly in its first flight, and the Spacelab equipment it requires would take up most of the Shuttle's payload bay. Lockheed has two points in its favor. The TALON GOLD device is much more compact than the IPS, and its selection would keep together the Lockheed design team. But its lack of a European partner may weigh against Lockheed.

This suggests that contract provisions that given preference to European contractors may disadvantage American firms, as well as the rate of progress in the SDI research program.

CONCLUSIONS

The lack of publicly available details on the recently signed MOU with the British makes it difficult to draw firm conclusions on the future of European collaboration in the SDI. To the extent that this and future agreements have not broken the barrier to extensive participation, European support for the SDI and the Administration's current posture in the Geneva arms talks will soon decline.

These barriers are not the result of bureaucratic caprice or historical accident, but of considered national policy. To the extent that these barriers have been broken, the Congress should inquire as to the implications of these changes in national policy.

There has already been some informal discussion in the Congrees of possible measures in response to the recent Memorandum. These suggestions have included:

- Special set-asides for Allied contractors could be prohibited;
- Evaluations of contract proposals could be prohibited from using bonus points for the inclusion of Allied sub-contractors;
- Issuance of Requests for Proposals to companies outside the U.S. could be limited to only those non--U.S. firms that have facilities that cannot be duplicated in the U.S.;
- All prime contracts could be limited to U.S. companies, unless there is a finding that a non-U.S. company has a unique capability that does not exist in the U.S.;
- The U.S. Government should retain property rights in the results of developments by non-U.S. companies that are the same as those applied to domestic firms;
- Allied countries could be required to contribute an amount equal to the value of the SDI contracts to a fund that would be used for contracts with U.S. firms.

Again, there is not enough information available today on the details of the Memorandum of Understanding recently signed with the British to determine which if any of these initiatives is called for. But there is clearly a need to look more closely at the implications of Allied collaboration in tne SDI.

FIGURE 4
BARRIERS TO EUROPEAN PARTICIPATION IN THE SDI
KEY TO FIGURE 5

1 (ABMT) = THE ANTI-BALLISTIC MISSILE (ABM) TREATY OF 1972
The ABM Treaty prohibits the transfer of ABM components or blueprints for such components to third countries.

2 (CAP?) = THE LIMITED CAPABILITIES OF EUROPEAN COMPANIES
European companies have limited expertise in many of the specialized technologies of the SDI. Existing technology cooperation and transfer procedures would inhibit or preclude significant participation by non-U.S. firms.

3 (COMM) - THE COMMERCIAL POTENTIAL OF SOME SDI TECHNOLOGY
Although the commercial spinoff potential of the SDI has been greatly exaggerated, the U.S. is unlikely to fund European work on technologies with possible commercial applications.

4 (NA) - SOME OF THE WORK MUST BE PERFORMED IN THIS COUNTRY
Some of the SDI consists of projects, such as facility management, that must by its nature be performed in the U.S., and European companies would not be eligible for such contracts.

5 (POSS) - THE COMPETITIVE ENVIRONMENT
European corporations will be eligible to compete for some contracts, but they must actually win contracts in competition with U.S. companies. In this environment, European corporations will win only a small fraction of the SDI contracts.

6 (YES) - THE PENALTIES OF FOREIGN PREFERENCES
Contracts that are set aside for European companies are insignificant in size, and even these may sacrifice technical performance requirements.

FIGURE 5
BARRIERS TO EUROPEAN PARTICIPATION IN THE SDI

CURRENT YEAR DOLLARS (millions)			1 ABMT	2 CAP?	3 COMM	4 NA	5 POSS	6 YES
TOTAL SD		30088	13637	10308	4201	959	953	30
			45%	34%	14%	3%	3%	0%
63220C	SURVEILLANCE		5611	4001	1476	189	212	25
0001	Radar Discrimination Tech			487				
0002	Optical Discrimination Tech			920				
0003	Imaging Radar Tech SBR			910			50	
0004	Imaging Laser Tech LIDAR			918			50	
0005	IR Sensor Technology			767				
0006	Boost Surveil & Track BSTS		1090					
0007	Space Surveil & Track SSTS		1594					
0008	Airborne Optical Syst AOS		1484					
0009	Terminal Imaging Radar TIR		888					
0010	Space-Based Imaging Demo		157					
0011	Common Tech & Architecture				1224			
0012	Program Management SATKA					125		
0013	SATKA Systems Studies		400					
0014	Director SDIO SATKA				252	64	112	25
63221C	DIRECTED ENERGY WEAPONS		3102	2929	330	216	354	0
0001	Space-Based Laser System		1406	777				
0002	Ground-Based Laser Systems		915	1268			71	
0003	Space-Based Particle Beam		390	647			216	
0004	Nuclear Directed Energy		222	188			45	
0005	DEW Concept Development					146		
0006	DEW SDIO Director		170	50	330	70	23	
63222C	KINETIC ENERGY WEAPONS		4924	1057	238	275	247	0
0001	Endo NNK Tech LEDI		450	99		15	89	
0002	Exo NNK Technology		172	264			158	
0003	System Eng and Analysis		97					
0004	Hyper-Velocity Launcher			545				
0005	Novel Concepts			149				
0006	High-Endo Defense Sys HEDI		1176					
0007	Exo RV Intercept Sys ERIS		1024					
0008	SLBM Boostphase Engagement		0					
0009	Sagittar space railgun		268					
0010	Space-Based KKV Rocket		1015					
0011	Terminal Tech Integ Demo		592					
0012	Program Management Army					260		
0013	Director SDIO		130		192			
0014	AMMRC				46			

FIGURE 5 (continued)
BARRIERS TO EUROPEAN PARTICIPATION IN THE SDI

CURRENT YEAR DOLLARS (millions)		1 ABMT	2 CAP?	3 COMM	4 NA	5 POSS	6 YES
63223C	SYSTEMS CONCEPTS & BMC3	0	777	1038	222	0	5
3001	Battle Management & C3			722			
3002	SDI Systems Architectures		777	316	222		5
63224C	SUPPORT PROJECTS	0	1543	1119	0	140	0
0010	System Survivability		641				
0011	Lethality & Hardening		902			50	
0012	Space Power & Conversion			682			
0013	Space Logistics			313			
0014	Other Support			125		90	
65898C	SDIO Management HQ				57		

Mr. VENTO. Thank you very much.

Really, I think your testimony is first-rate in terms of raising many questions, especially in terms of the barriers. I note both of your statements pointed out that you felt that the ABM Treaty, the 1972 treaty, through clause G and article IX, apparently is a limitation on foreign participation.

Would you comment on the limitations? You heard the discussion between myself and Mr. Yonas on the very matter.

Ms. Marlin.

Ms. MARLIN. I think Mr. Pike is more qualified to speak to that particular issue than I am.

Mr. VENTO. Mr. Pike.

Mr. PIKE. The article IX and statement G limitations were placed in the treaty in response to the concerns of both the United States and the Soviet Union that it would be possible to evade the provisions of the treaty simply by developing or transferring these technologies to other countries. The Soviets, in particular, were concerned that the United States might develop an arrangement with European countries, such as we have had in the past and continue to have today with the British, on the sharing of nuclear technology that might allow us to develop or deploy these systems in Europe.

I think it is very clear, both from the plain text of the treaty and from the negotiating history of the treaty, that there are very strict limitations on what we can do in cooperating in this area with our European allies. Almost half of the SDI budget consists of money for the development and testing of the types of ABM components limited by the treaties, ABM interceptors, ABM radars or systems based on new physical principles that can substitute for interceptors or radars.

There are some things not limited by the treaty. The treaty is silent on the question of ABM battle management, computer hardware and software, and so imposes no limitation in that area. But in terms of doing the hardware intensive and, consequently, expensive and lucrative development of antimissile interceptors, the treaty makes it very clear that we can't transfer that to the Europeans and can't even transfer blueprints.

Mr. VENTO. Best intentions aside, it sounds to me like that the Europeans want to avoid the serialization of information that they have apparently felt subjected to in the past by virtue of participation with our research efforts, especially when they have national security or strategic implications.

And it sounds to me like we are getting into a morass of agreements where indeed we will do certain things and share certain information with the United Kingdom and perhaps with other countries down the road. Those agreements—I don't know the specifics, but they will share certain information so they will, in fact, have that assistance.

As I said in my bantering with Mr. Yonas, he said there is some sort of magical line out here which at some point we can't step across. That is almost assuredly going to result in conflicts with regard to what they can and can't do, isn't that true?

Mr. PIKE. I think they have a real problem here. Either the Europeans are going to get nowhere close to the amount of money that they have decided that they want in return for political support for the SDI, or we are going to have to have yet another reinterpretation of what the treaty means and have to go beyond the existing bounds of the treaty. If we stay within the treaty, clearly the Europeans are going to be relegated to the sort of subcontractor role where they make the very small widgets and do the initial research——

Mr. **Vento**. Mr. Pike, from a technical standpoint, are we incapable in this country, in your judgment, of carrying out the research and development and science, basic science, that is being raised with regard to the SDI Program or not?

Mr. **Pike**. I think it is very clear that the consistent judgment of the people who have been running this program for at least the last 15 years, the Army people down in Huntsville and certainly General Abrahamson's office for the last several years, is that not only is the United States fully capable of developing all of this technology, but the contracting record suggests that companies outside of the United States simply do not have the expertise needed to develop these systems.

Mr. **Vento**. Then isn't all of this negotiation really pulling us in the wrong direction? Isn't it a diversion and theoretically a slowing down of actually getting on with the task? If this is going to be national public policy, irrespective of the fact that a minority agree in Congress and a majority disagree in the Nation, wouldn't then these contracts be a delay, a deterrent, and potential security risk?

Mr. **Pike**. To the extent that foreign contracting in the SDI comes anywhere close to meeting the expectation of our European allies as to the dollar value involved, I think that would clearly be the case. To the extent it doesn't meet those expectations, I think the administration is going to be in increasing hot water with the Europeans.

Mr. **Vento**. You pointed out the problems with some of the spinoffs, the commercial spinoffs, I guess. You suggested, that there is not a very meaningful attainment based on a $76 billion program.

I guess these spinoffs are good things to have, but I think there is probably a better way to get to them than spending $76 billion. I don't disagree from a scientific standpoint that we ought to be able to share on a full global basis information on a lot of things. I don't have that problem, but I think if we are going to spend the money here, the concern I have is the fact there is a certain human resource that becomes developed and associated with the basic science, the basic R&D that goes into this, that will be lost to us if indeed we give away 20 percent of it or contract or agree to have 20 percent developed in Europe. That is 20 percent that we lose of that type of expertise.

Now that is a very important commodity in terms of schooling and in terms of training engineers. I feel that necessity is the mother of invention, and if, in fact, we need the physicians, engineers, that the schools and the other institutions will put them out.

But if you deny them the dollars to do this, then you will not attain that goal. It will be attained somewhere else.

Mr. **Pike**. I think that the problem that the administration faces is that they haven't been able to sell the Europeans on the SDI, so they have decided to lend their support to try to shore up——

Mr. VENTO. I think this is an expensive education program we are embarking on to win their support notwithstanding some of the other things.

I have to go vote. I am not going to keep you. You have been patient this afternoon, you have other travel plans. Your testimony has been very helpful in us trying to gain some understanding, appreciation of the impact of this on our defense industrial base, and I hope that we will get further answers and have General Abrahamson appear before the subcommittee with a full explanation of the memorandum of understanding. Thank you for your participation.

The meeting stands adjourned.

[Whereupon, at 4:05 p.m., the subcommittee was adjourned subject to the call of the Chair.]

[Response to questions by Congressman Vento from Mr. Yonas were subsequently received for inclusion in the record:]

RESPONSE TO QUESTIONS BY CONGRESSMAN VENTO FROM MR. YONAS

Question 1. What criteria will be used in determining allied participation at every level in specific areas of the SDI research program?

Answer. All levels of allied participation in SDI research programs will be primarily determined by the technical merit of the proposals presented. There are some research facilities and teams of scientists in allied nations that are doing work which can assist the U.S. in successfully accomplishing specific SDI research projects more quickly and/or less expensively.

Question 2. What criteria are used in awarding SDI research to domestic industries and academic institutions?

Answer. Participation in SDI research programs by U.S. industries and academic institutions will be based upon the institution's ability to contribute to the goals of the SDI program. Technical expertise is the single most important criterion for awarding SDI research contracts to industry or academic institutions either at home or abroad.

Question 3. Please describe the process which you have followed and will follow in contacting and subsequent negotiations with those allies who have responsibilities (responded) to the initial U.S. invitation to participate. That is, please expand and clarify your testimony presented to the Subcommittee on December 10, 1985 on pages 16–17.

Answer. Contracting arrangements and proposals are handled in accordance with current DoD contract and procurement regulations. However, the implementation of a formal government-to-government agreement or memorandum of understanding (MOU) may in some cases impose new requirements or alter existing ones for specific projects jointly undertaken in the SDI program. Any change in requirements pursuant to a MOU will be in accordance with U.S. law and regulations. Each Allied participation case will be administered individually due to differences in existing U.S./Allied defense contracting arrangements, security classification procedures, and technology transfer regulations. However, Allied participation in SDI research will not result in any general relaxation of controls affecting the security of information.

Question 4. Attached is an article from the December 10, 1985 Christian Science Monitor regarding research to undermine the goals of SDI. Has SDIO funded, is it now funding or will it fund any research directed towards the development of any weapons systems to penetrate or avoid a Soviet SDI system?

Answer. No, the SDIO has not funded, is not funding, and will not fund any research directed towards the development of weapon systems to penetrate or avoid a Soviet SDI system.

Other elements of the Department of Defense are engaged in efforts to modernize our nuclear retalitory forces. This is necessary to reestablish and maintain the offensive balance in the near term and to create the strategic conditions that will permit us to pursue complimentary actions in the area of arms reduction negotiations and defensive research. The SDIO itself remains dedicated to demonstrating the feasibility of reducing the risk of nuclear war through greater reliance on strategic defenses.

Question 5. Is Allied participation in the SDI research a violation of Article IX or Agreed Statement G of the ABM Treaty? When does Article IX or Agreed Statement G of the ABM Treaty become effective? That is, what allied participation is precluded by the Article IX of Agreed Statements of the ABM Treaty?

Answer. Allied participation in SDI research does not violate Article IX or Agreed Statement G. Those provisions would preclude the U.S. from providing the Allies with technical descriptions or blue prints specially worked out for the construction of ABM systems and their components limited by the Treaty.

Question 6. What process will SDIO use in awarding contracts to Allied governments, agencies or foreign firms?

Answer. The procedure for awarding contracts to Allied firms will be the same as that for U.S. firms, namely, merit-competition consistent with U.S. national policy and international obligation as in contracting with U.S. firms, in certain cases, however because of specific expertise possessed by certain allied firms of research institutions in particular areas, sole source contracts may be awarded. Allied firms proposals will be evaluated by the same standards and criteria to U.S. firms' proposals.

Question 7. Beyond existing agreements and procedures, what steps have been or will be taken by DoD to insure the security of SDI research in this country and abroad?

Answer. At the SDIO we have made industrial security a number one priority when dealing with domestic or foreign contractors. At all levels, SDI security should be thought of as a layered security concept: with less sensitive or non-classified "basic research" on the outside layer, while more sensitive technologies are carefully protected in succeeding inner layers with ever increasing security requirements. We have explained to potential participants that to participate in the more sensitive areas they will have to meet very stringent security requirements. Moreover, there will be areas of SDI Research which, because of their extreme sensitivity will not be open to non-U.S. contractors.

Cooperative research efforts with our allies will be conducted in strict accordance with our National Security Information Disclosure Policy. This policy provides for the protection of both sensitive unclassified as well as classified material.

In negotiating with our allies we will incorporate into the contracts a series of agreements to prevent the unauthorized transfer of SDI technology to the Soviet Union or its allies. Furthermore, no work will begin in areas that are sensitive or classified until proper arrangements, including security measures, are satisfactorily completed and agreed upon.

Finally, allied governments, as well as U.S. authorities, are making major efforts to tighten security. Security risks to our sensitive technologies are a matter of great concern in all Western nations.

Question 8. Please describe the intended operation of the Office of Educational and Civil Applications to insure the widest possible use of SDI-related technologies for civil use. Consistent with security considerations, with all foreign research and development be under the jurisdiction of this office and be made available to U.S. companies, scientists, and universities?

Answer. Though national security considerations will be paramount, the SDI Directorate of Educational and Civil Applications will function to encourage the widest possible application of SDI-related technologies in the public and private sector. The Directorate will strive to motivate education and industry to see and understand new ways, methods, and technologies and how they might be used to enhance our national economy.

Question 9. Will the SDIO follow DOD policy on endangered American industries and the Department's Buy American guidelines?

Answer. It is not the intention of SDIO, in implementing the MOUs agreed with Allies, to bypass any of the normal DOD procurement laws and regulations.

Question 10. Will foreign participation in SDI research at any level (government, industry, or academic institutions) directly or indirectly, benefit the European EUREKA project?

Answer. At this time the European EUREKA project has no definite charter, organization, or formal structure. It is difficult to estimate what role this concept may eventually play in the European scientific and technical research establishment.

However, as it has been explained to date participation by a European firm in EUREKA would not be incompatible with participation in SDI.

Question 11. Is there a precedent for foreign participation in primary research for a U.S. project?

Answer. Certainly, there are precedents for foreign participation in U.S. defense programs. For example there was extensive allied involvement in all phases of the F-16 program and the space shuttle program.

Question 12. What are the impacts on U.S.—foreign government Memorandums of Understanding for SDI on the Defense Production Act. For example, what are the impacts on the Master Urgency List and the Industrial Preparedness Planning List?

Answer. U.S.—foreign government Memorandums of Understanding for the SDI will not have any impact on the Defense Production Act, the Master Urgency List or the Industrial Preparedness Planning List.

Question 13. On page 17 of your statements to the Subcommittee, you outline possible implementing arrangements and specifically discuss cost sharing. Will cost sharing be a part of every government-to-government Memorandum of Agreements?

Answer. In discussions with Allies, the DoD has always identified jointly funded cooperative research efforts under a memorandum of agreement as one of several generic means to Allied participation in the SDI program.

Question 14. Will foreign participation in SDI Research and Development (R&D) reduce the U.S. R&D costs of this program?

Answer. There are excellent scientific and industrial capabilities in Allied countries, in many SDI technical areas. There are also a number of primer facilities amongst our Allies. The use of these facilities, and the need not to replicate them in the United States, could reduce program cost.

Question 15. It is my understanding that SDI Research and Development contract procedures call for continual competition among contractors. Under this process, those contractors that fail to produce will be dropped from funding. For foreign contracts, how will you insulate the technical evaluation from international political consideration? How will this process be affected under a cost sharing agreement?

Answer. We have consistently told Allies that participation in the SDI Program will be implemented consistent with normal DoD procurement laws and regulations which emphasize competition in contracting. Our demand for technical excellence and our insistence in using existing DoD procurement procedures apply just as fully to allied as to U.S. participation in the research program.

Question 16. What will be the long-term impact upon U.S. companies of foreign SDI research and development? Will U.S. funding of foreign research result in the subsidy of the competitors of domestic industries. Has the Department of Defense conducted any studies or analyses to determine the impacts of U.S. funding of foreign research on U.S. industries?

Answer. We believe that the long-term impact of Allied participation is a stronger program with potentially lower cost-consistent with our stated objectives to examine technologies for ballistic missile defenses for the United States and its Allies.

Question 17. At present, how many engineers, scientists, and other technical people are working on SDI funded research and development? How many engineers, scientists, and other technical people will be working on the full scale SDI research and development program?

Answer. The majority of SDI work is awarded by open competition to private sector contractors. Because of the complexity of categorizing the number of people, by skill area, working in the private sector on SDI efforts that information is not readily available. Congress commissioned its own study on this subject last year. The study concluded that neither SDI nor private industry would be significantly impacted by a shortage of scientific skills available to work on SDI contracts.

Question 18. What areas of expertise has the SDIO found U.S. industries and academic institutions lacking the ability or resources for research and development? What commitment will SDIO make to improve the human resources in these areas?

Answer. We firmly believe that U.S. industrial and academic institutions are potentially capable of handling all aspects of SDI research. We have found, however, that in certain areas our allies have a measurable lead compared to U.S. efforts. With the expert potential that projects already established by our allies can offer, it makes little sense for us to "take the long road" and start from scratch.

By offering institutions and industries the opportunity to research the most innovative technologies, the program has become the catalyst for new interest, ideas, developments in both the defense and civilian worlds. The program is committed to providing American industries and institutions with the incentive and facilities for research on the forefront of technology.

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